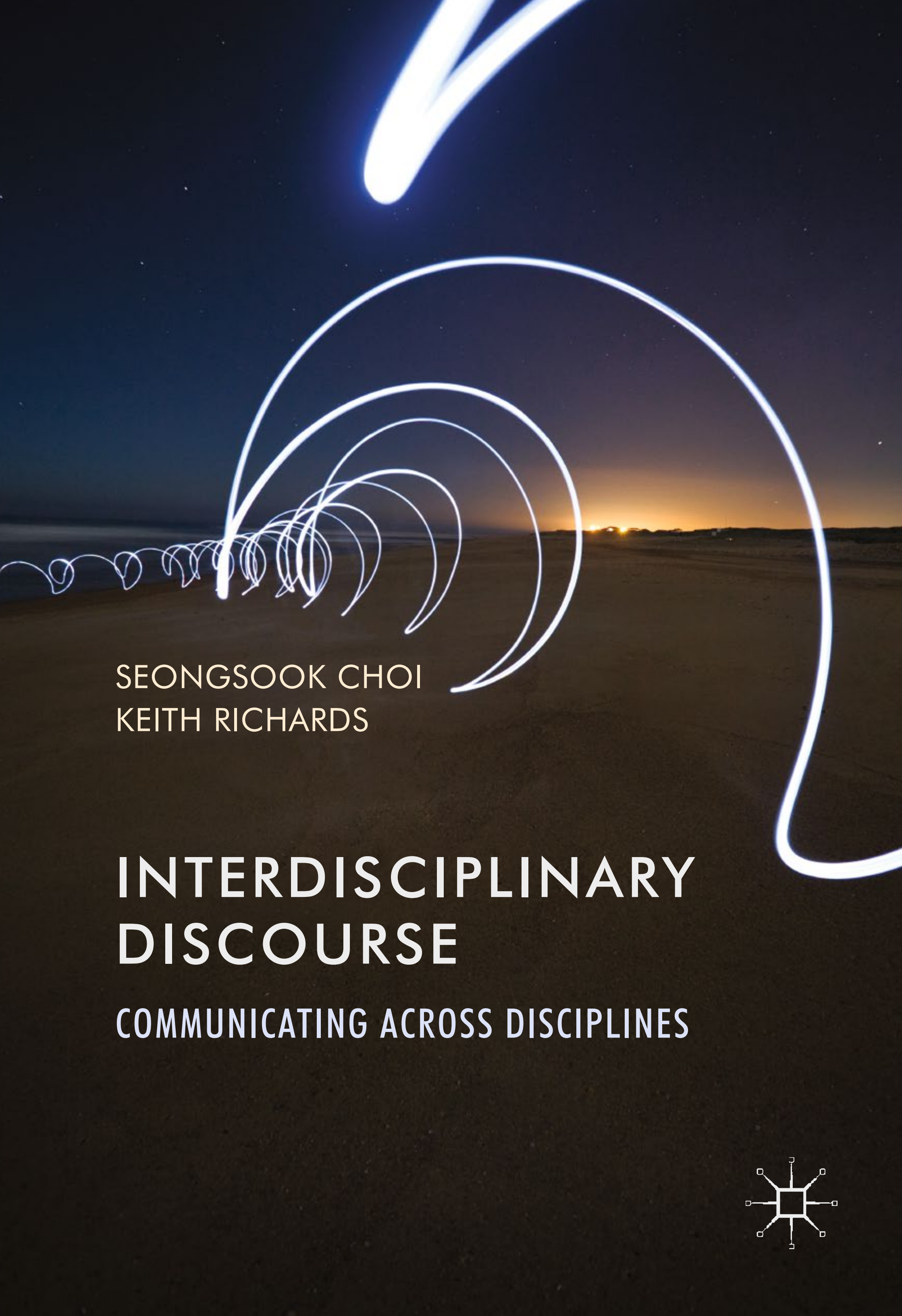

SEONGSOOK CHOI
KEITH RICHARDS

INTERDISCIPLINARY DISCOURSE

COMMUNICATING ACROSS DISCIPLINES

Interdisciplinary Discourse

Seongsook Choi • Keith Richards

Interdisciplinary Discourse

Communicating Across Disciplines

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Introduction

Reading it Differently

*Extract 1.1

01	Dave:	We could actually do the analysis of variance of the time series
02		(if the xxxx are good)
03	Joan:	Yeah!
04	Dave:	(xxx) make any difference
05	Doug:	No
06		(4.0)
07	Joan:	As [long as it's not] a problem when we publish it that's=
08	Dave:	[(It'd be good.)]
09	Joan:	=what-[(we'd need.)
10	Lucy:	[They're unlikely to read it back.
11		(1.0)
12	Joan:	Exactly. I mean [certainly] if a biologist reads it they won't=
13	Lucy:	[It's okay]
14	Joan:	=even think about it. But (2.0) if a statistician reads [it
15	Doug:	[If a
16		statistician reads it they'll (.) tell you it's wrong to the analysis
17		(and xxxxx) theory

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(0.5)
Dave: Mm
Joan: Well it is [a standard] (xxx) condition [(xx xxxxx)
Doug: [It assume-] [It assumes that the
time question…
(WSBPR0526/5-00:27:40)

*For details of transcription conventions used, see Appendix 1

The above extract is taken from a systems biology meeting forming part of a shared project involving specialists with different disciplinary backgrounds. Members of the team have been discussing a problem in their analysis and considering whether a reanalysis of some of the data is necessary, a discussion that comes to be framed in terms of what the implications might be if they publish a paper including the analysis. The extract begins with the end of a suggestion from Dave that prompts agreement from Joan and Doug and, after a reasonably lengthy pause, a response from Joan suggesting that what matters is whether this will represent a problem if it's published. Lucy adds support to the idea that it will be unproblematic by suggesting that 'they' (the prospective reviewers of the paper) will be 'unlikely to read it back'. Having agreed with this suggestion, Joan then raises an interesting distinction between two possible categories of reader: biologists and statisticians (lines 12–14). She claims that the former will not give the issue a second thought but implies that it might be problematic for the latter, a point taken up emphatically by Doug, who goes on to indicate where the problem might lie.

This short extract highlights a number of interesting issues that bear on the relationship between disciplines, three of which will be considered here. The first and most obvious point is that reference to disciplines is seen as unproblematic: When Joan refers to biologists and statisticians, these labels are treated as adequate descriptors for the purposes of the discussion that follows. While many of those present would describe themselves as systems biologists, the success of their interaction in these meetings depends in large part on their contributions as specialists in what might be described as their parent disciplines. This is reflected in a second aspect of the extract: the way in which participants speak as members of their discipline and are careful not to cross unstated but implicitly accepted boundaries dividing this from other disciplines. In lines 12–14 Joan, a biologist herself, speaks confidently and authoritatively about what a biologist will 'certainly' do, but she stops short of making claims about how a statistician might respond. She marks the coming contrast with the adversative conjunction 'but', then pauses for two seconds, leaving the floor open. When no response is forthcoming, perhaps because the nature of the contrast has not been made explicit, she goes on to indicate the nature of the distinction involved. Once this is clear, she does not even finish the subordinate clause that precedes details of the contrast (line 15) before Doug, a statistician, speaks for his discipline. The fact that Joan makes no effort to complete her statement in the face of this interruption confirms that she has designed her turns to allow a representative of the relevant discipline to speak. This does not mean that she will necessarily agree with the general position (the fact that line 20 is prefaced with 'Well' implies a lack of alignment with Doug's claim), but if she disagrees it will be as a biologist.

The third aspect of this exchange that we wish to highlight relates to the way that the talk develops and points to something quite fundamental about the nature of disciplines. At issue here is the importance—or perhaps more precisely, the relevance—of a piece of analysis. On the surface at least, the claim that a biologist (lines 12–14) won't give a second thought about something that for a statistician would represent a fundamental flaw (lines 15–17) might be seen as critical of the former, positioning the biologist as in some way more slapdash than the statistician. And yet it is a biologist who makes this claim and nowhere in the talk, either in this extract or anywhere else, is there any suggestion that a biological analysis would be defective or in any way inadequate. One of the most basic challenges in interdisciplinary engagement arises from the fact that different disciplines have very different ways of understanding things, dealing with things and representing things: What may be of fundamental importance in one discipline may be of no more than peripheral relevance in another. When disciplines engage, these differences need to be negotiated, usually without the convenience of being able to frame them in terms of reviewer differences.

Finding the 'Inter' in Interdisciplinarity

The US National Academies are unequivocal: 'At the heart of interdisciplinarity is communication' (National Academies 2005: 19). It is odd then that so little attention has been paid to this aspect of interdisciplinarity in the research that is currently available. Reference is made to it in models and typologies, researchers reflect on their experiences of it and case studies underline its importance, yet the communication itself remains largely unexamined, a mystery at the heart of the interdisciplinary enterprise. The aim of this book is to penetrate some of that mystery and at the same time to demonstrate why it is important to understand better the nature of interdisciplinary interaction.

The small taste of interdisciplinary engagement in Extract 1.1 highlighted just some of the issues that arise when different disciplines are brought together in order to achieve shared objectives, though as an analysis it lacks the depth and range that is necessary to expose the interactional mechanisms that enable interdisciplinary work to get done—or undermine its effectiveness. It is beyond the scope of any single book to consider all of these or to cover the many different forms of interdisciplinarity that exist, but in what follows we use discourse analysis to shine a light on aspects of them, providing support for some of the findings of current research into this area and challenging the accuracy of others. In doing so, we hope to contribute to the rich fund of insights that already inform interdisciplinary activity.

As Chap. 3 will show, interdisciplinarity is a relatively recent phenomenon but already a fixed feature of the academic landscape. It may be overstating the case to claim, as do Henkel and Vabo (2006: 135), that it is 'regarded as a precondition for innovations and collaboration between industry and the overall needs of the knowledge society', but its burgeoning presence has much to do with its capacity to deliver practical solutions to pressing problems that are beyond range of single disciplines. It is important therefore to understand interdisciplinary research, and in particular what factors promote or inhibit its success, in order to design support and training that will maximise its impact and thereby its contribution to society. In order to do this we need to identify not only the institutional and academic contexts in which it can be nurtured and the internal structures and configurations that promote success, but also how the day to day business of interdisciplinary research gets done. This takes many forms, but at its core are the research meetings in which the different disciplines involved engage in order to accomplish a range of things including establishing shared understanding, resolving differences, confronting challenges, planning, agreeing action and building a community of researchers—all of which are achieved through talk. Such meetings and the interaction of which they are constituted make an essential contribution to the success of interdisciplinary projects and in examining the discourse through which interdisciplinary business is talked into being, this book takes up, like Klein (2005: 7), 'one of the most neglected topics in the literature—How does one actually *do* interdisciplinary work?'

The Structure of the Book

The book is divided into two parts, the first introducing interdisciplinarity and identifying key issues that bear on our understanding of it. It is designed to provide an overview of the subject and more specifically to establish why the research featuring in this book is necessary. The second part of the book presents the findings of the research itself and concludes with a discussion of how these might inform interdisciplinary practice.

Chapter 2 focuses on the disciplines because these are the foundations of all interdisciplinary work. It provides a historical context for understanding some of the forces that influence the development of interdisciplinarity, working towards a conclusion that makes the case for the importance of interactional relationships in interdisciplinary communities. The chapter includes three cases that illustrate the complex relationship between disciplines and interdisciplines, and the different ways in which new interdisciplines emerge.

Chapter 3 also includes a very brief historical overview, but its main concern is with different forms of interdisciplinarity and the typologies and models that have been advanced in order to represent these. It uses this as the foundation for discussing the experience of interdisciplinarity and the factors influencing interdisciplinary success, highlighting the need for greater understanding of how research teams interact.

Chapter 4 takes up this theme, providing a rationale for the approach adopted in the book. It begins by explaining why and how interaction is fundamental to the success of interdisciplinary research before moving on to consider previous work on communication in this context, recognising its contribution but also highlighting its limitations. Particular attention in this discussion is drawn to assumptions that have been made about the nature of interaction and the emphasis that has been placed on terminological challenges at the expense of interactional ones. The second half of the chapter examines previous approaches to researching interdisciplinarity, highlighting the limitations of the case study and interview-based methods that have so far predominated. This sets the scene for a discussion of discourse-based research and a description of the approach used in the book.

Chapter 5 is the first of two chapters with an epistemological focus. These examine the extent to which a standard model of stages in interdisciplinary research can be applied to the data set used in the book, beginning in this chapter with interaction in initial meetings. It begins with an introduction to work on epistemics in talk then develops an analysis of two initial interdisciplinary meetings on different subjects and with different aims. For the purposes of comparison, it also includes a brief consideration of an initial meeting in an interdiscipline, systems biology.

Chapter 6 completes work begun in the previous chapter on stages in interdisciplinary research. This time attention is directed to the way in which knowledge is constructed collaboratively. The analysis draws on data from a number of interdisciplinary meetings, some from within systems biology involving different projects and others from a specific research project bringing together the social sciences, biology, mathematics and economics. The second part of the chapter identifies a discourse marker that plays an important part in the building of understanding and draws attention to a significant interactional pattern in which it features. In its conclusion the chapter returns to the issue of terminology in interdisciplinary engagement and challenges a widely accepted claim.

Chapter 7 is concerned with identity and most of the analysis is dedicated to the ways in which this plays out in systems biology research meetings. This interdiscipline is particularly relevant because it is at an interesting evolutionary stage and involves two groups of disciplines: those concerned with conducting experiments (known as 'wets') and those who work with the data from these experiments (known as 'dries'). The analysis of their interaction in the chapter indicates that in some situations there may be serious but hitherto unnoticed interactional problems of which even the participants themselves are unaware.

Chapter 8, the final analytical chapter in the book, explores the dynamics of leadership and the different forms it can take in research project meetings. It addresses the ways in which leadership activities and processes such as decision-making, negotiating and reaching consensus are discursively constructed by team members, and how different forms of leadership are instantiated through research interactions.

Chapter 9, the Conclusion, summarises the main findings of the research in the book and its contribution to our understanding of interdisciplinary research. It highlights outcomes that either reinforce or call into question current thinking on the nature of interdisciplinary engagement and makes some tentative suggestions on how interdisciplinary engagement might be improved and how trainers, leaders and the researchers themselves can contribute to this. The book concludes with a plea for a significant broadening of research perspectives on interdisciplinary work and indicates what approaches this might embrace.

References

Henkel, M., & Vabo, A. (2006). Academic identities. In M. Kogan, M. Bauer, I. Bleiklie, & M. Henkel (Eds.), *Transforming higher education: A comparative study* (2nd ed., pp. 127–159). Dordrecht: Springer.

Klein, J. T. (2005). *Humanities, culture, and interdisciplinarity: The changing American academy*. Albany: State University of New York Press.

National Academies. (2005). *Facilitating interdisciplinary research*. National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. Washington, DC: The National Academies Press.

2

The Disciplinary Landscape

Introduction

Interdisciplinarity begins with the disciplines because, as Aldrich (2014: 13) so succinctly puts it, 'there is nothing to be "inter" about without disciplines coming first.' Disciplines, as Lattuca (2001: 23) has noted, are complex phenomena. At their most basic level, and as used in the extract that opened this book, they provide convenient labels as points of reference, widely used and largely unquestioned; but when the substance behind the label is tested, as it must be in interdisciplinary contexts, its complexity represents a significant challenge. Bluntly put, disciplines cannot be neatly characterised in ways that will allow them to be used as building blocks in the construction of new academic entities.

This chapter therefore begins with a consideration of the nature of the disciplines and the issues associated with them, moving from a historical overview, through an examination of the essential characteristics of the discipline and some relevant epistemological considerations, to a consideration of the ways in which disciplines might be brought together. This provides the basis for describing the different forms of collaboration and the terminology associated with these.

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A Brief History of the Discipline

Many researchers would agree at least to some extent with Strathern (2004: 45) that disciplinary distinctness is a convenient fiction, but this is not the same as denying the very real and powerful presence of disciplines in the worlds of education and research. This section provides a brief account of the development of the disciplines focusing on the nature of this presence and its implications.

The starting point for a historical overview in itself offers an interesting insight into ways in which the discipline might be viewed. Moran (2010), for example, begins his account in the ancient world, tracing the roots of the discipline to Greek philosophy and in particular Aristotle's hierarchical organisation in terms of theoretical, practical or productive orientations. This starting point directs attention to the relationship between disciplines and the organisation of knowledge while at the same time serving as an interesting reminder that prejudice in favour of theoretical fields at the expense of applied subjects is longstanding. Other writers (e.g. Salter and Hearn 1996) begin their accounts in the Middle Ages with the formation of the first European universities, in which students followed a standard core curriculum before going on to specialise. Three aspects of this are particularly salient from the perspective of disciplines today. The first is the concept of the institution as a community of scholars, an idea that still has some resonance, and the second is the link between the specialisms and the professional world beyond the institution, exemplified in the study of medicine and the law. This development was to become more relevant as disciplinary configurations hardened in the nineteenth century, but it is the third aspect, the embedding of the discipline within formal structures and systems, which is perhaps of most interest. In order to understand this it is necessary to trace the process by which the first universities emerged.

Universities grew out of the cathedral schools, which, as the name suggests, were centres of learning attached to major religious institutions. At first relatively informal, these schools burgeoned as part of what has become known as the twelfth-century renaissance, though without the formal structures associated with universities. Rather, they were points of attraction for scholars, who were free to set up their own schools provided that they could attract a sufficiently large body of students. Perhaps the most well-known scholar of the period, Abelard, serves as a useful illustration of the very individual character of these precursors to universities. He first joined the Cloister School of Notre Dame in Paris, where he challenged the authority of the leading realist philosopher, William of Champeaux, attracting students away from the latter. Ill health brought on by overwork eventually led to Abelard's departure from Paris, but he returned after six years to set up his own school in Mont St. Geneviève again attracting a significant following, and even when later in life he retreated to a hermitage near Troyes, students sought him out in large numbers. Gradually, however, the relatively open and peripatetic system in which Abelard flourished gave way to the development of more stable institutions. The shift, and its significance, is admirably captured by Lloyd (1939: 70):

> Everything which divides modern Cambridge from twelfth-century Paris is then only a matter of time and logical development. The closed corporation, with rules, privileges, strict conditions of entry, undertaken for the purposes of mutual help and protection – this makes the university. It may be a corporation of masters as at Paris, or a corporation of scholars founded as protection against the greed of landladies and shopkeepers as at Bologna. It does not matter by which route the essential goal is approached. Once the germ of the guild system of trade and industry is applied to any educational centre, it has ceased to be a school and becomes a university.

The contrast between, on the one hand, the pursuit of knowledge through intellectual rivalry independent of institutional constraints, and on the other access to it via the structures and systems of a formally established university could not be more profound. It is within the context of the latter that disciplines—and following from this the structures of interdisciplinarity—need to be understood, and it is within this framework that the force of Foucault's conception of the 'disciplining' of knowledge, in which the discipline serves to regulate conduct, finds purchase.

The historical moment at which the discipline evolves into its modern form from this context is conventionally located in Prussia in the early nineteenth century with the development of secular research-oriented universities under state control. The intellectual foundations of this can be traced to the rise of the natural sciences and the Enlightenment drive to encyclopaedic classification, but the main drivers were to be found in developments outside the institution. The most powerful of these were increasing industrialisation and associated technological developments, creating the demand for a system that would supply trained technicians and professionals for industry while also feeding the results of research into industrial development. The resulting specialisation in turn contributed to the development of hierarchical systems within hardening disciplinary boundaries, a process strengthened by competition for funding and links with associated learned societies. The effects of these developments are reflected today in the departmental organisation of universities, the award of degrees in specific subjects, the existence of learned bodies with clear disciplinary affiliations, associated journals, and so on, and at the heart of the disciplinary enterprise is a relationship between universities and society, including the professions.

It is commonly claimed that the Prussian system was the prototype for the modern European and North American university. Moran (2010), for example, argues that although the resulting proliferation of disciplines attracted some criticism aimed at over-specialisation, the close links between education within the discipline and the pursuit of a career associated with that discipline, combined with the institutional power and independence of the university, ensured that such reservations were essentially peripheral. Abbott (2001: 122–131), however, proposes a different perspective on disciplinary history, one which places the US system at the heart of developments. This system, he argues, is unique and has remained largely unchanged for a century, influencing developments in Europe and elsewhere. While recognising the historical significance of nineteenth-century developments in Germany, he argues that the system there left little scope for expansion and that career development depended on moving from institution to institution, maintaining the same narrow research focus even when the move involved a nominal change of field. The consequences of this, he claims, were that the disciplines in the modern sense did not develop; instead '[t]here was intense cultivation of small areas, which were then surrounded by large tracts of empty intellectual space' (2001: 124).

Abbot's views of the French and English university systems at this time are also worth noting in passing because of the way in which they draw attention to important cultural differences within a broadly disciplinary structure. French university education in the late nineteenth century, he argues, tended towards the vocational, with powerful chairs but no research institute structure. Paris was seen as the elite centre, attracting the best minds at the expense of the regions and allowing the development of a career advancement system dependent on patronage groups and clusters. In contrast, he claims, English universities were resolutely unprofessional and often anti-research, with a strong—usually college-based—patronage structure. Exam content rather than disciplinary orientation was central to the system, producing what was in effect a pedagogically oriented approach.

The development of US universities, Abbott argues, involved combining undergraduate teaching systems based on the English model, with graduate research institutions on the German model, producing strong departmentalisation reinforced by the formation of national disciplinary societies. The implications for career development in this system are particularly striking. Advancement is necessarily within disciplines, with disciplinary networks providing candidates for appointment by national disciplinary bodies. All universities have roughly the same departments and since career prospects depend on the disciplinary system as a whole, universities are obliged to work within this. Hence, disciplinarity is reinforced, and attempts to reconfigure disciplinary structures within an institution are likely to flounder because of the resulting negative impact on the career prospects of academics working outside the conventional framework. Even the removal of a department has no significant impact because in such cases, Abbott argues, a 'bubbling' system closes the resulting disciplinary gap, and the integrity of the system as a whole is preserved. There is in any case, he claims (2001: 43), considerable overlap between disciplines, allowing them to 'rejuvenate each other by a system of reciprocal theft'.

The system of majors in US universities further reinforces this disciplinary structure, representing a serious challenge to interdisciplinarity that is not present in the UK system, where undergraduate programmes are not necessarily disciplinary. Abbott refers to 'dual institutionalization' in the case of the former: 'on the one hand in an interuniversity labor market annually transacting tens of thousands of faculty and on the other in an intrauniversity curriculum annually "disciplining" millions of students' (2001: 28).

Whether or not Abbott's positioning of the US system in the historical development of the discipline is accepted, his insightful analysis of the relationship between individual disciplines and the broader disciplinary structure produces a telling account of the power of the discipline to influence both the student curriculum and the career structures of academics. A corollary of this is that interdisciplinarity might serve to undermine the power of disciplines as mechanisms of control and hence threaten the positions of those involved in exercising such power, though what interdisciplinarity might represent will depend in part on an explication of the nature of the discipline itself. The next section addresses this.

Characterising the Discipline

Although there is no general agreement on how academic disciplines should be characterised, the history of their development has already pointed to aspects that would need to feature in any comprehensive formulation. This section explores ways in which the disciplines have been characterised, using this to identify core aspects and develop a description that can form the basis for a working definition. Its aim is to convey a sense of their complexity and how deeply they are embedded within broader social, institutional and intellectual structures.

As an initial approach to understanding the nature of disciplines, building on the historical perspective already established, it is helpful to consider them as entities within a broadly institutional framework. This produces a list of aspects that would be relevant to the activities of any discipline:

- *Organisational* (Henkel)

> We have therefore taken the discipline and the enterprise, or the higher education institution, as the main institutions or communities within which academics construct their identities, their values, the knowledge base of their work, their modes of working and their self-esteem. (Henkel 2000: 22)

The historical development of the discipline has taken place within the context of the university as an institution and in order to understand it we therefore need to take account of the institutional context and the community of scholars associated with it.

- *Epistemological* (Aldrich)

> To speak of scholarship as disciplinary, or by extension interdisciplinary, means one expects the scholarship to be interconnected with other organized knowledge, and to be part of an intellectual and organizational framework that is commonly recognized by a community of scholars. (Aldrich 2014: 16)

Perhaps the most fundamental aspect of the discipline, though in terms of precise delineation the most challenging, is its connection with a body of knowledge and associated ways of deriving, organising and representing this. This provides a foundation for the mechanisms of control and evaluation that were mentioned in the previous section.

- *Cultural* (Becher)

> …each discipline clearly has its own particular qualities. These are not, of course, purely epistemological. Disciplines are also cultural phenomena: they are embodied in collections of like-minded people, each with their own codes of conduct, sets of values and distinctive intellectual tasks. (Becher 1981: 109)

Disciplines are also collectivities, groups of individuals within departments, learned organisations, panels, etc. who develop ways of doing things that are not merely local but in many respects common across the discipline. These would be realised through what Trowler (2014) calls 'disciplinary practices' such as research, teaching and administration. He notes, however, that such practices will be inherently unstable and contextually contingent. Huber (1990: 242–244) has taken this further, extending the 'traits associated with the disciplines' to 'practices and preferences in private lives' and social background, while Murray and Renaud (1995) provide evidence that teachers in different academic disciplines approach teaching differently.

- *Mora*l (Ylijoki)

> I am proposing that at the core of the disciplinary culture can be conceptualized as a moral order. The moral order constitutes the main distinctions concerning the vices and virtues of the local culture: what is considered to be good, right, desirable and valued as opposed to what is regarded as bad, wrong, avoidable and despised. (Ylijoki 2000: 341)

  One aspect of the cultural dimension of a discipline is the ways in which moral beliefs and norms of behaviour are associated with membership so that, for example, while one discipline might tolerate public attacks on the academic integrity of claims made by conference speakers, members of another discipline might consider this reprehensible. Strober (2011: 33–34), for example, describes how in an interdisciplinary meeting a participant from the religious studies department publicly chastised an economist for his forthright criticism of a paper given by a mathematician, a response that he considered acceptable in his own field.

- *Political* (O'Neill and Meek)

> … the self-regulation of professions has as much to do with the politics of knowledge as with anything else. This is especially so for the academic profession, with its stake in controlling knowledge production and dissemination. (O'Neill and Meek 1994: 97)

  The fact that disciplines are institutionally embedded brings with it an inevitable political dimension, but from a disciplinary perspective it is the politics associated with the control of knowledge that has definitional purchase.

This characterisation captures some key aspects of the discipline, but it fails to do justice to its intellectual dimensions, the aspects most associated with academic endeavour with roots that go further back than the foundation of universities. The model proposed by Repko (2008), on which a number of researchers have drawn (see, for example, Kalra and O'Keeffe 2011), is based on the notion of *disciplinary perspective*: 'the ensemble of a discipline's defining elements that include phenomena, assumptions, epistemology, concepts, theory, and methods' (2008: 58). The relevant elements can be described as follows:

Phenomena:	These are aspects of human existence that are the object of scholarly interest.
Assumptions:	These are the taken-for-granted principles underlying the discipline as a whole.
Epistemology:	A discipline's epistemology represents its ways of knowing those aspects of the world that fall within its purview.
Theory:	This Repko (2008: 101) sums up as 'a generalized scholarly explanation about some aspect of the natural or human world'. As generally understood, a theory has a predictive or explanatory function.
Method:	This refers to how research is conducted, how data are collected and analysed as part of the process of creating new knowledge.

In keeping with his perspectival approach, Repko (2008: 53) suggests that disciplines act like lenses through which the world is seen and interpreted. Unsurprisingly perhaps, metaphor has offered a way of characterising disciplines that may be illuminating but is at the same time highly selective. Kellert (2008: 36–39) summarises some of the metaphors that have been proposed:

Disciplines as nations: Disciplines have territory, domains; there are borders, limits (if not precisely defined at least there in the sense that some things are in and some out); there may be Balkanisation or tribalism; migration is possible (e.g. Klein 1990: 77).

Disciplines as tiles: Kellert mentions Giere's (1999) collage of pictures (multiple perspectives) and Campbell's (1969) ideal fish-scale pattern in which narrow specialities overlap, where in reality they tend to pile up leaving interdisciplinary gaps. However, Campbell's metaphor produces a very different picture from Abbot's (2001: 126) concept of bubbling, 'in which disciplines like drops of oil scatter more or less uniformly over a surface and expand toward each other'.

Disciplines as languages: Bauer (1990) talks of different grammars as well as different words. To this might be added Shulman's (2002: vii) 'different ways of talking' that develop out of engagement with problems and topics associated with their field of study.

The multiplicity of perspectives on the discipline is almost as extensive as the range of disciplines themselves and the following might be added to Kellert's list:

Disciplines as families: Strathern (2004: 45) argues that disciplines 'are ways of keeping distinct the origins not just of ideas and materials, but of work practices, lines of authentication and accountability'. She argues that their distinctness is a convenient fiction and offers an interesting metaphor of the family, contrasting sustaining lineal identities with procreating new identities out of the engagement of parents with different origins.

Disciplines as cartels: Turner (2000: 51) takes even further Abbot's claims regarding the importance of disciplines in the employment market, characterising them as 'cartels that organize markets for the production and employment of students by excluding those job-seekers who are not products of the cartel'. Although this perhaps fails to give due weight to other forces in the market, it nevertheless reflects a potential of disciplines to be closed worlds dedicated to perpetuating the status quo.

An aspect not included in the above list is the relationship between the department and the discipline. It is excluded because nobody has seriously suggested that the two can be conflated. However, there is a strong association between them, and Aldrich (2014: 17) has claimed that the department is 'the smallest collective component of a scholarly discipline'. The problem with establishing too strong a link between the two is that it serves to reinforce the reductionist tendency in disciplinarity, as highlighted by Sarewitz (2010: 65):

> …in general the disciplines support an inductive, reductionist view of understanding, where larger-scale insight is supposed to arise from the accumulation of facts and insights acquired through inquiry focused at

> smaller scales. Reductionist, disciplinary approaches to knowledge acquisition thus encourage mechanistic views of nature and society, views that treat the subjects of reductionist analysis as more significant than the interactions among such subjects

The wide range of approaches to characterising the discipline not only reflect the difficulty of arriving at a definitive description but also point to the many dimensions that may need to be considered when researching in this area. When disciplines are brought together, for example, relational issues are bound to emerge and authority may well be a site of contestation; issues of who has the authority to speak on behalf of the group, on what basis and in what ways, and so on, will not be easy to resolve. Institutional authority, for example, is very different from epistemological authority, which in itself may operate with disciplinary boundaries: while group members may be expected to challenge epistemic authority within their own discipline, extending this to other disciplines may be proscribed, and directing challenges to institutional authority might even be regarded as a disciplinary matter.

At its most basic level, interdisciplinarity involves the engagement of different disciplines however this might be configured. What this might represent and how it might be operationalised will depend to no small extent on the nature of the disciplines involved, but if these are inherently resistant to precise characterisation and are multidimensional in nature, the interactional investment in developing productive ways of being and working will be considerable. The focus of this book is on the nature of that investment.

Towards a Definition

While some understanding of the nature of the discipline is essential for the analysis in the chapters that follow, it is also helpful to have in mind a definition that will serve as a point of reference. The foregoing characterisation of disciplinarity provides support for Trowler's (2014: 1721) suspicion of essentialist definitions, and while there are virtues in simplicity there are also dangers of imbalance, as the following examples show:

> Disciplines are socially constructed traditions of inquiry that have been formalised within university structures but which fulfil cultural and epistemological purposes in addition to their organisational function. (O'Connor and Yates 2014: 3)

> We have therefore taken the discipline and the enterprise, or the higher education institution, as the main institutions or communities within which academics construct their identities, their values, the knowledge base of their work, their modes of working and their self-esteem. (Henkel 2000: 22)

In fairness to the authors involved, these are not presented formally as definitions, but they seem designed to serve this purpose. The first covers an impressively wide range of aspects in a very short space, but attention is directed to the discipline as an intellectual enterprise functioning within an institutional context. The description is accurate as far as it goes, but the reference to social construction hints at, without fully representing, the importance of the community of scholars who make up the discipline. In contrast, the second quotation captures this very effectively, but the reference to a knowledge base is a rather restricted representation of the academic aspects of a discipline.

The extent to which these dimensions feature in any particular discipline will vary and may depend in part on whether the discipline is, to use the distinction proposed by Salter and Hearn (1996), tightly bounded or loosely bounded, the former imposing more stringent criteria for membership and exercising greater control over members than the latter. Such variations add weight to Trowler's (2014) claim that disciplines are best understood as manifesting family resemblances rather than sharing essential characteristics. His definition represents an attempt to identify the range of considerations that might be applied to disciplines rather than a specification of core characteristics, and although this necessarily produces a rather long formulation, it is one that provides a helpful point of reference:

> Disciplines are reservoirs of knowledge resources which, in dynamic combination with other structural phenomena, can condition behavioural practices, sets of discourses, ways of thinking, procedures, emotional responses and motivations. Together this constellation of factors results in

> structured dispositions for disciplinary practitioners who reshape them in different practice clusters into localised repertoires. While alternative recurrent practices may be in competition within a single discipline, there is common background knowledge about key figures, conflicts and achievements. Disciplines take organisational form, have internal hierarchies and bestow power differentially, conferring advantage and disadvantage. (Trowler 2014: 1728)

Mapping the Disciplines

While disciplines enjoy a considerable degree of intellectual autonomy, they function within organisational contexts alongside other disciplines. The extent to which the relationships arising from this will impinge on any particular individual will vary, but the nature of academic work makes encounters with related fields inevitable and membership of an institution brings with it at least some basic awareness of other elements within the institution. When researchers become involved in interdisciplinary work they bring with them knowledge, assumptions and possibly prejudices about other disciplines and their ways of working that may influence the ways in which these scholars engage with their new colleagues. For this reason, it is useful to understand something of the disciplinary landscape.

The introduction of interdisciplinarity involves realignment that may be only temporary, sustained for no longer than the lifetime of a particular project or may involve the creation or evolution of a more permanent feature of the disciplinary landscape. It is therefore useful to know something of the way new disciplines or subfields emerge. An important aspect of this will be the relationship between the new discipline and the parent discipline, evolving in the form of either natural growth away from the latter or rejection by the former. The relationship between disciplines will be the theme of this section, which will begin with attempts to map the disciplinary landscape and what these have revealed in particular about the status of different disciplines. Issues of status have particular relevance to the ways in which new disciplines or subfields emerge, and this will form the subject of the second part of the section, which will be illustrated by reference to particular cases.

The classic typology of disciplines was first proposed by Becher (1989) and developed further by Becher and Trowler (2001), working from the assumption that the structure of knowledge within each discipline is the primary factor influencing disciplinary culture and that allegiances associated with this produce tribal characteristics. Becher (1989) produced a typology of disciplines organised in terms of their paradigmatic and theoretical orientation (hard or soft) and their knowledge application (pure or applied). This produces 'hard-pure' (natural sciences such as physics), 'soft-pure' (humanities and social sciences), 'hard-applied' (technologies such as mechanical engineering) and 'soft-applied' (applied social sciences such as education). He also identified epistemological and cultural characteristics associated with each discipline, though as Brew (2008) notes, the term 'tribes' is used far more sparingly in the second edition (Becher and Trowler 2001) than it is in the first. The rapidly changing higher education scene may have something to do with this, but the rise of collaborative research and the shifting disciplinary landscape must also be factors worthy of consideration. Interestingly, Krause takes this further, identifying evidence of a fragmentation of disciplinary tribes while noting that departmental and disciplinary units play a vital role in providing academic staff with a voice in the academy. He argues that although academics may have a strong affinity with a research community, 'academic staff feel more like nomads than tribal members when it comes to teaching in their discipline' (2014: 17).

While Becher's descriptions have been widely accepted, Repko's (2008: 60–112) application of his own notion of disciplinary perspective to different disciplines produces a comparative map of core disciplines in the academy, which is rich in telling detail. His representation of the learning and thinking processes of academics (2008: 78) may indirectly owe much to debates on paradigmatic differences that were characteristic of late twentieth-century paradigm wars, but it is suggestive of the conceptual gulfs that need to be bridged by academics collaborating across faculties. While the natural sciences adopt an inductive approach that is knowledge intensive and analytic in its orientation, producing a view of humanity as subject to natural laws, social scientists are more concerned with theory construction, measurement and textual analysis, a perspective that sees human behaviour as patterned and governed by identifiable laws and principles.

This distinction has much in common with that proposed by Salter and Hearn (1996), who argue that while some disciplines see themselves as theory-driven, others are research-driven. Interestingly, they provide the example of sociologists and economists in Canada, the former regarding their discipline as theory-driven and the economists characterising their discipline as driven by empirical research, though the fact that economics is included (conventionally) under the social sciences in Repko's model suggests that broader divisions are indicative rather than binding.

The gap between the sciences—human or natural—and the humanities is even more pronounced. Drawing, as before, on Donald (2002), Repko describes the approach in humanities subjects as based on 'contemplative perception', with a focus on significant texts, objects and behaviours. The associated view of human behaviour treats it as something unique, even idiosyncratic. He also claims that it is seen as resulting from free will rather than being determined, though this makes his inclusion of philosophy in the list of relevant disciplines problematic because in that discipline the nature of human action is an object of inquiry having as one of its most prominent topics the free will debate.

Such matters do not undermine the value of Repko's analysis; rather, they reinforce the overriding impression of significant and quite fundamental differences between the disciplines. This is not necessarily a barrier to interdisciplinarity but it is most certainly a challenge that needs to be met. It is perhaps not surprising that Becher (1981: 109) found academics to be 'surprisingly hazy' in characterising other people's subjects of study, but where collaboration is involved some basic understanding must be established and the ways in which this is constructed and instantiated are legitimate objects of research. Focusing on the behaviour—in this book on the linguistic behaviour—of those involved when different disciplines are brought together is based on similar assumptions to those which underlie Strober's (2006: 318) argument for using departmental identity as a proxy for discipline:

> Using departmental status as a proxy for discipline is akin to using revealed preference theory in economics. Economists point out that in studying the behavior of consumers, it is difficult to know, *a priori*, their underlying tastes and preferences. However, once consumers make a purchase, their

> behavior reveals those underlying tastes and preferences. Similarly, although academics cannot agree in the abstract which branches of knowledge are disciplines, by observing their collective behavior in making what they think are disciplines into departments, the definition of disciplines is revealed.

Status is, in fact, an aspect of disciplinary relationships that may be particularly salient in the development of interdisciplinary engagement. The literature is rich in examples reflecting implicit hierarchies both within and between disciplines, the most fundamental of which is that between 'pure' and 'applied' subjects first made explicit by Aristotle. And while Becher's typology is not in itself hierarchical, its categories comprise these two along with 'hard' and 'soft', a contrast that is often drawn—with implicit asymmetry—between the natural sciences such as physics and human sciences such as biology. Kellert (2008: 72) refers to the rhetorical power and prestige of natural sciences in our culture that allows them to invoke 'disciplinary prestige'. The implications of this for academics working in disciplines perceived as less prestigious have been starkly spelt out by Metziger (1987: 132):

> …ordinarily a well-born subject, for instance a descendent science, fared well … but a baser subject, such as engineering or a modern language, had often confronted an apparatus of invidiousness—inconvenient course hours, discounted degree credits, low faculty status—that kept it in an inferior place

This invidiousness extends beyond the academy, entering everyday discourse in the form of references to 'Mickey Mouse' degrees and manifesting itself in the form of prejudice against the 'seriousness' of some subjects. At the same time academics themselves tend to see some disciplines as having high status, and the departments associated with them tend to have higher than normal rates of inbreeding, that is faculty members who were once graduate students in the same department (Hagstrom 1971: 386). Such perceptions even influence motivations for engaging interdisciplinary relationships, either because of the prestige arising from association with high-status disciplines, or conversely because interdisciplinarity can offer a challenge to the status quo (Moran 2010: 8).

While this may represent a relatively minor issue at institutional level, it becomes far more significant when different disciplines are brought together, representing a potentially powerful barrier to effective interdisciplinary engagement. This involves not merely controlling agendas or claiming precedence but may reveal itself in more subtle ways in the interaction of participants. Discourses characteristic of what is perceived to be the more 'prestigious' partner may come to dominate other discourses, closing down possible avenues of exploration or distorting the ways in which different positions are represented. The projection of one form of expertise onto the territory of others may, by virtue of its perceived status, be granted more authority than it in fact warrants (Lyne 1990: 53). As Chap. 7 of this book will reveal, these are practical matters with potentially important consequences, and they can be better understood by examining the ways in which such authority is talked into being. The examination of interdisciplinary interaction is therefore a matter of more than merely academic interest.

Knowledge Matters

Aldrich's (2014: 18) view that disciplines 'stand for quite stable and robust ways of organizing knowledge' is a commonly accepted one, and the different epistemological foundations informing this are associated with different ways of understanding. Any discipline will therefore have established parameters within which it is possible to identify

- what counts as relevant knowledge;
- how such knowledge can be organised;
- how such knowledge should be represented;
- how research should be conducted and evaluated.

These allow the development of criteria for judgement that inform peer review and determine appropriate membership, from which will emerge leaders in the field and its main means of distributing and sharing knowledge (journals, professional bodies, etc.).

This description, while accurate in general terms, lends a more definitive edge to the discipline than is discernible in practice. In fact, researchers who have interviewed academics have discovered that some can be very vague when it comes to defining the discipline within which they work. They often draw on more than one disciplinary area in what Brew (2008: 430) calls 'confluence', a finding which suggests that little has changed since Becher's (1981) interviews with academics revealed that they did not see their disciplines in homogeneous terms, instead emphasising their complexity and variety.

There is, of course, a world of difference between someone's treating the context within which they work as perfectly clear and unproblematic from the perspective of their day-to-day activities but finding it difficult to define, explain or even describe that context when asked to consider it as an object of critical scrutiny. Garfinkel's ethnomethodological studies are grounded on the insight that, for members, quotidian accomplishments 'are unproblematic, are known vaguely, and are known only in the doing which is done skillfully, reliably, uniformly, with enormous standardization and as an unaccountable matter' (1984: 9–10). In the everyday conduct of their professional business, academics will orient to their discipline in a variety of ways according to the demands of the situation, but in order to function effectively they will treat the discipline itself as essentially unproblematic.

The implications of this for researching interdisciplinarity are that while interviews with academics might be revealing in many respects, they are not necessarily the best way of understanding how these academics relate to their discipline in their everyday professional practices. And it is precisely these practices, and the assumptions underlying them, that may be problematised when members are called upon to orient to other disciplines in conducting interdisciplinary research. While direct access to the thinking of participants in situ may not be possible, what is available is the evidence of this in their talk. Interdisciplinary research is built on collaboration constructed through the talk of participants involved, in which the negotiation of epistemological issues will feature prominently.

In considering this it is also worth bearing in mind that the development of disciplinary expertise is interactively achieved. The process of socialisation into the discipline involves novice members engaging with more experienced colleagues and they in turn with peers in addressing a commonly recognised set of problems. In the course of this, they develop not only ways of understanding but also ways of speaking that are characteristic of their discipline, acquiring what Turner refers to as a form of communicative competence. While his characterisation of the product of disciplinary training as 'a community or audience of persons who can understand what is said' (2000: 52) may go too far in terms of its exclusivity, it nevertheless underlines the importance of the linguistic dimension in disciplinarity. It also makes a vital link between ways of speaking and a community of scholars. For some writers (e.g. Aldrich 2014) the absence of such a community represents a significant problem for interdisciplinary research, though it might equally well be argued that an essential feature of such research is the *building* of a functioning community. The interactive processes will necessarily be different because of the different disciplines involved, but participants will not be entirely unfamiliar with the nature of interactional adjustment and accommodation in the academic world. If research into their interaction can serve to deepen their understanding of this it should thereby contribute to more effective interdisciplinary research.

Disciplinary Growth

The development of interdisciplinary groups is not the only form of change in universities that brings into focus disciplinary differences and alignments; it can also be instructive to consider how new disciplines emerge within academic institutions and how questions of identity are addressed within the discipline. In order to do this, three case studies are examined, each throwing light on some of the issues identified in this chapter relating to the nature of disciplines and relationships between them.

Most new disciplines evolve from what were originally sub-disciplines, driven by emerging differences of interest and orientation that give rise to the desire for autonomy. In practical terms, the most obvious advantage of being recognised as a discipline is that this can form the basis for being awarded departmental status (Strober 2006: 317), which brings with it autonomy and its attendant benefits, as well as increased status within the institution itself. However, the process of emergence will inevitably involve a disturbance of the status quo and may raise important epistemological, organisational or even interpersonal issues, as revealed in the first two case studies that follow.

Moving Away from the Discipline: Computer Science

Clark's (2006) focus on the development of computer science serves to address his broader interest in the factors that contribute to the development of a new discipline. Computer science first appeared on the academic scene in the 1950s, associated with mathematics and engineering, and is now widely accepted as part of the academy, so its developmental trajectory is a relatively long one. In Leeds University, the site of Clark's interviews with six long-standing academics in the field, it stretched from 1957, when a computing laboratory was established as a semi-autonomous unit in the mathematics department, to the separation of the formal two disciplines within the university structure in 1979.

The three elements making up the new disciplinary territory were mathematics, computer engineering and data processing, and it was the applied nature of the last two, Clark argues, that helps explain its eventual split from mathematics. While the initial association with mathematics, a high-status subject, may have been an important factor in helping it to gain initial acceptance, the importation of non-mathematical subject matter into computer science produced a feeling amongst mathematicians that it was unacademic. They came to see it as something of a cuckoo in the nest, and the chairman of the School of Mathematics went so far as to dismiss its claims to be regarded as a serious academic subject.

While academic considerations were prominent in the separation from mathematics, issues of personality also seem to have played their part, though perhaps less centrally so than two years earlier in the split from the university computing service and the formation of a Centre for Computer Studies that involved two professors who, in the words of one academic, 'really hated each other'. Other factors contributed, not least the installation of new computers in the university and the burgeoning demand for places on computer studies courses, and Clark describes the two separations as influenced by serendipitous factors which were as much micropolitical as organisational and developmental.

In some cases, technological and societal changes may make the development of a new discipline almost inevitable, but the importance of Clark's paper is that it shows how the movements towards this are driven by a combination of local factors in which individual relationships may be particularly important. The understandable emphasis of most research into interdisciplinary work is on the organisational and intellectual challenges and opportunities associated with it, but anyone seeking to analyse the day-to-day workings of an interdisciplinary group needs also to bear in mind the potential relevance of interpersonal dynamics.

Developing Apart from the Discipline: Psychosocial Studies

Computer science might be said to have been the product of two parents, engineering and mathematics, and although its emergence necessarily involved separation from these, there is no sense in which it could be said to have explicitly rejected them. However, in some cases separation from the parent discipline involves rejection of it, whether explicit or implicit. Frosh (2003) argues that such has been the case with psychosocial studies. Psychology, he notes, is a broad discipline merging at its boundaries with other disciplines such as sociology, biology and the brain sciences. Its orientation may be predominantly empirical, he argues, but the nature of its work means that it 'acts rather like the humanities in deepening perception rather than in accumulating knowledge; it is also very much like other social sciences, increasing local understanding without making a giant, universal step forward' (2003: 1546). Against this background, psychosocial studies have arisen out of two issues confronting the discipline: the extent to which psychology has served as an instrument of state in contexts such as health, education and security, and the ideological investment in the 'individual' as the subject of study with its associated assumptions about the relationship between the individual and society.

While the genesis of computer science was the outcome of factors external to its parent disciplines (in particular, technological advances), psychosocial studies emerged as part of a critical response to elements within the discipline itself. As a result, Frosh points out, few initiatives to establish centres or departments of psychosocial studies have arisen out the discipline itself, instead coming from areas such as sociology and psychoanalysis. The result, he argues, is that the intellectual base is set up in opposition to, or at least isolation from, psychology, leading to a 'de-psychologizing' of psychosocial studies and a missed opportunity. His discussion of Birkbeck College's Centre for Psychosocial Studies is designed as a response to this situation, demonstrating how maintaining the link with psychology can be beneficial.

The case of psychosocial studies brings out clearly the fluid nature of disciplinary boundaries and the extent to which these are subject to constant negotiation within the context of a discipline's ideological and political ambitions. As Frosh notes, this establishes a natural context for interdisciplinary engagement. His vision (2003: 1562–1563) for psychosocial studies within the broader context of disciplinary affiliations and associated competitive individualism might also stand as a legitimate aspiration for interdisciplinary work: 'to create a setting in which ideas and people can be supported, can find a creative place for themselves in a situation of solidarity'.

Doubts About Disciplinary Identity: Applied Linguistics

The two cases considered so far have illustrated how new disciplines or fields of study might emerge from already existing ones and what this process might reveal that is relevant to interdisciplinary research, but there is another perspective that does not appear to have featured prominently in studies of disciplinarity: the extent to which disciplines might exist, even flourish, with no general agreement as to their academic core. It is, after all, one thing to regard the boundaries of a discipline—indeed, any discipline—as not clear-cut, but quite another to assert this of the discipline as a whole.

Applied linguistics offers a good example of a discipline that has thrived without ever resolving fundamental issues related to its identity, and this despite the availability of books dealing with its history (e.g. de Bot 2015) and even an argument for building applied linguistic historiography (Smith 2016). As its name suggests, it emerged from linguistics, but the nature of its connection with the parent discipline has never been satisfactorily resolved. It is a relatively new discipline, emerging as a distinct presence in the 1950s and firmly established by 1980, the year in which the first issue of its flagship journal, *Applied Linguistics*, appeared. That the issue of identity is still very much a matter of concern is evidenced by a special issue of the journal in 2015 'dedicated to providing definition and ways forward for the field of applied linguistics' in which the editor notes that 'there is no reason to expect that we have defined the terms and boundaries of the field. For that reason, we might want to pose such definitional questions with some regularity' (Hellermann 2015: 419).

While the intricacies of the debate are not relevant here, its basic contours provide a useful example of why interdisciplinarity cannot be regarded as simply a matter of bringing together separate disciplines and how it may be embedded within the existential substance of a single discipline. A consideration of two different characterisations of applied linguistics, one by its leading international association and one by its flagship journal, serves to illustrate this:

> Applied Linguistics is an interdisciplinary field of research and practice dealing with practical problems of language and communication that can be identified, analysed or solved by applying available theories, methods and results of Linguistics or by developing new theoretical and methodological frameworks in Linguistics to work on these problems. (International Association of Applied Linguistics)

> *Applied Linguistics* publishes research into language with relevance to real world problems. It promotes principled and multidisciplinary approaches to research on language-related concerns in the various fields encompassed by applied linguistics. (*Applied Linguistics*)

The element that both definitions have in common is a feature of all definitions of applied linguistics: its concern with practical 'real world' problems. However, it would be odd if an applied subject did not have this orientation, and beyond this shared element the two definitions have little in common. The first remains close to the parent discipline, placing linguistics firmly at the core of the new discipline's activities, while the second refers only to language-related concerns, which extend the range well beyond linguistics, perhaps reflecting the significant influence of social theory on work in the field. Similarly, while the association identifies applied linguistics as an interdisciplinary field, the journal is less definitive, opting instead for a reference to multidisciplinary approaches.

In doing this, *Applied Linguistics* situates itself very carefully, avoiding the term 'interdisciplinary' and hence sidestepping a debate at the heart of identity debates. For while some (e.g. de Bot 2015) identify applied linguistics as interdisciplinary, others explicitly reject this (e.g. Widdowson 2000), emphasise instead its diversity and complexity (e.g. Brumfit 2004) or reject its claims to disciplinarity and propose alternatives such as 'subject' (Davies and Elder 2004). The range of positions is extensive, running from those regarding applied linguistics as a discipline, or at least an emerging discipline, to those who see it as fatally fragmented:

> A quick look at a number of well-recognized disciplines will reveal that they too are open to charges that their fields are too fragmented and too broad, that they demand expertise in too many related subfields, and that they do not have a set of unifying research paradigms. … In the case of other disciplines, time and recognition have provided a much greater sense of inevitability, a sense that is likely to accrue to applied linguistics over the next 50 years. (Grabe 2010: 6)

> We are now surely less a federation than a collection of independent states, some isolationist, some even at war. To mix metaphors, the hoped-for expansion, rather than enriching and empowering applied linguistics, has been the origin of a fatal fragmentation which has overtaken any sense of common purpose, and rendered historical any discussion of the field as a whole, and I see no grounds, other than the dictates of nostalgia, for attempts to jigsaw back together the scattered shards. (Cook 2015: 431)

The academy seems equally unsure of where applied linguistics might be placed, with the result that it appears in the form of departments or centres in Schools or Faculties of Modern Languages, Education or Language and Communication, as sections in departments such as linguistics or education, or sometimes as unattached centres or units within the institution. Despite the unresolved identity issues at its heart, as Kramsch (2015: 460) notes, it 'has shed its existential angst… and slowly gained the respect of scholars in the Humanities and the Social Sciences'. In this it is not alone, and the situation it represents highlights the importance of not entering discussions of interdisciplinarity on the assumption that the lack of a clear identity, recognised boundaries or even core attributes are problems unique to it.

Conclusion: Working from the Discipline

Working from the assumption that interdisciplinarity necessarily involves the bringing together of different disciplines and that some understanding of the nature of the latter is therefore essential, this chapter has considered aspects of disciplinarity, from its historical foundations to the ways in which the concept has been understood, metaphorically, epistemologically and structurally. Having established parameters of understanding and representation, it then moved on to represent some of the complexities of disciplinary perspectives suggesting that disciplines may of themselves bring challenges into any interdisciplinary relationship. In addition to these, there may be other ways in which disciplinarity and interdisciplinarity rub up awkwardly against one another and the chapter concludes by considering some of these.

Research suggests that academics take disciplinary allegiances very seriously, not only ideologically but as matters of professional responsibility. Kreber's (2000) study involving 58 academic staff, for example, revealed that experienced academics saw learning about their discipline and learning about teaching as important aspects of their work and regarded these as closely related. Since the growth of interdisciplinarity threatens to undermine the power and autonomy of the discipline, such perfectly natural allegiances might influence the ways in which academics approach interdisciplinary engagement. An example of this is provided by Robert Axlerod's presidential address to the American Political Science Association (2008, quoted in Aldrich 2014) in which he described interdisciplinary research in terms of 'importing' from another discipline in order to apply whatever is imported within one's own discipline and 'exporting' something from one's own discipline through showing how it can be applied in another discipline. He described how he was able to export an idea from his own field to cancer research to explain the nature of cooperation between cancer cells but also identified an interesting challenge arising from disciplinary affiliation: that disciplines are generally more interested in imports that can advance their own discipline than exports that might benefit another.

This suggests that although ivory tower isolation may be perceived negatively (Ylijoki 2000: 345), the move to collaboration may nevertheless bring with it some elements of the view from the tower. Striking the right balance between discipline and interdiscipline is important and, as Kellert notes (2008: 45), problems can arise if activities in the latter context come to be seen as more important than disciplinary pursuits. There may also be personal or political factors that influence the motivation to engage in interdisciplinary research, all with the capacity to distort perspectives and relationships. Moran rather provocatively suggests, for example, that in the humanities, interdisciplinary study 'is often an attempt to challenge the pre-eminence of the sciences as a model for disciplinary development, based on the belief that they can obtain neutral, objective forms of knowledge within their own areas of inquiry' (2010: 8).

Once a commitment to interdisciplinary research is made, the individuals concerned are involved in *boundary crossing*, a process that involves entering unfamiliar territory for which they may be largely unqualified (Suchman 1994: 25; Choi 2017). Socialisation within a discipline generates not only natural affinities with particular modes of understanding and investigation but also involvement in a particular community, something that interdisciplinarity often lacks, with potentially damaging consequences for career progression insofar as this is influenced by senior members of established disciplinary communities.

The building of interdisciplinary communities is necessarily an extended and complex evolutionary process, but the foundations must be laid early by establishing effective interactional relationships. Akkerman and Bakker (2011: 19) identified four 'dialogical learning mechanisms' involved in boundary crossing:

1. *identification*, which involves developing an understanding of how the diverse practices involved relate to one another;
2. *coordination*, which depends on creating 'cooperative and routinized exchanges between practices'
3. *reflection*, through which perspectives on the relevant practices are expanded; and
4. *transformation*, arising from the collaborative codevelopment of new practices.

Our focus in this book is on the ways in which the first two of these are interactionally achieved. The challenges to this achievement are considerable, not least because, as many researchers in the field have noted, the epistemic barriers that need to be crossed 'involve incompatible styles of thought, research traditions, techniques, and language that are difficult to translate across disciplinary domains' (Jacobs and Frickel 2009: 47). As the next chapter will reveal, this has led many of them to characterise interdisciplinarity in interactional terms for, as Strober (2011: 4) has memorably observed, 'talking across disciplines is as difficult as talking to someone from another culture.'

References

Abbott, A. (2001). *Chaos of disciplines*. Chicago: University of Chicago Press.

Akkerman, S. F., & Bakker, A. (2011). Boundary crossing and boundary objects. *Review of Educational Research, 81*(2), 132–169.

Aldrich, J. H. (2014). *Interdisciplinarity*. Oxford: Oxford University Press.

Bauer, H. H. (1990). Barriers against interdisciplinarity: Implications for studies of science, technology, and society (STS). *Science, Technology, and Human Values, 15*, 105–119.

Becher, T. (1981). Towards a definition of disciplinary cultures. *Studies in Higher Education, 6*(2), 109–122.

Becher, T. (1989). *Academic tribes and territories: Intellectual enquiry and the cultures of disciplines*. Milton Keynes: Open University Press.

Becher, T., & Trowler, P. (2001). *Academic tribes and territories: Intellectual enquiry and the culture of disciplines* (2nd ed.). Buckingham: Open University Press/SRHE.

Brew, A. (2008). Disciplinary and interdisciplinary affiliations of experienced researchers. *Higher Education, 56*(4), 423–438.
Brumfit, C. (2004). Applied linguistics in 2004. Unity in diversity In S. M. Gass and S. Makoni, *World Applied Linguistics. A Celebration of 40 Years of AILA. AILA Review, 17*, 133–136.
Campbell, D. T. (1969). Ethnocentrism of disciplines and the fish-scale model of omniscience. In M. Sherif & C. W. Sherif (Eds.), *Interdisciplinary relationships in the social sciences* (pp. 328–348). Chicago: Aldine Publishing.
Choi, S. (2017). Collaborating beyond boundaries. In J. Angouri, J. Holmes, & M. Marra (Eds.), *Negotiating boundaries at work*: *Talking and transitions*. Edinburgh: Edinburgh University Press.
Clark, M. (2006). A case study in the acceptance of a new discipline. *Studies in Higher Education, 31*(2), 133–148.
Cook, G. (2015). Birds out of dinosaurs: The death and life of applied linguistics. *Applied Linguistics*, *36*(4): 425–433.
Davies, A., & Elder, C. (2004). Applied linguistics: Subject to discipline. In A. Davies & C. Elder (Eds.), *The handbook of applied linguistics* (pp. 1–15). Oxford: Blackwell.
De Bot, K. (2015). *A history of applied linguistics: From 1980 to the present*. London: Routledge.
Donald, J. (2002). *Learning to think: Disciplinary perspectives*. San Francisco: Jossey-Bass.
Frosh, S. (2003). Psychosocial studies and psychology: Is a critical approach emerging? *Human Relations, 56*(12), 1545–1567.
Garfinkel, H. (1984). *Studies in ethnomethodology*. Cambridge: Polity Press.
Giere, R. N. (1999). *Science without laws*. Chicago: University of Chicago Press.
Grabe, W. (2010) Applied linguistics: A twenty-first-century discipline. In Robert E. Kaplan (Ed.), *The Oxford handbook of applied linguistics* (2nd ed.). Oxford: Oxford University Press. http://0-www.oxfordhandbooks.com.pugwash.lib.warwick.ac.uk/view/10.1093/oxfordhb/9780195384253.001.0001/oxfordhb-9780195384253-e-2. (Oxford Handbooks Online).
Hagstrom, W. O. (1971). Inputs, outputs, and the prestige of university science departments. *Sociology of Education, 44*(4), 375–397.
Hellermann, J. (2015). Three contexts for my work as co-editor: Introduction to the special issue. *Applied Linguistics, 36*(4), 419–424.
Henkel, M. (2000). *Academic identities and policy change in higher education*. London/Philadelphia: Jessica Kingsley.
Huber, L. (1990). Disciplinary cultures and social reproduction. *European Journal of Education, 25*(3), 241–261.

Jacobs, J. A., & Frickel, S. (2009). Interdisciplinarity: A critical assessment. *Annual Review of Sociology, 35*, 43–65.
Kalra, P., & O'Keeffe, J. K. (2011). Communication in mind, brain and education: Making disciplinary differences explicit. *Mind, Brain and Education, 5*(4), 16–171.
Kellert, S. H. (2008). *Borrowed knowledge: Chaos theory and the challenge of learning across disciplines*. Chicago: The University of Chicago Press.
Klein, J. T. (1990). *Interdisciplinarity: History, theory and practice*. Detroit: Wayne State University Press.
Kramsch, C. (2015). Applied linguistics: A theory of the practice. *Applied Linguistics, 36*(4), 454–465.
Krause, K.-L. D. (2014). Challenging perspectives on learning and teaching in the disciplines: The academic voice. *Studies in Higher Education, 39*(1), 2–19.
Kreber, C. (2000). How university teaching award winners conceptualise academic work: Some further thoughts on the meaning of scholarship. *Teaching in Higher Education, 5*, 61–78.
Lattuca, L. R. (2001). *Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty*. Nashville: Vanderbilt University Press.
Lloyd, R. (1939). *The golden middle age*. London: Longmans.
Lyne, J. (1990). Bio-rhetorics: Moralizing the life sciences. In H. W. Simons (Ed.), *The rhetorical turn: Invention and persuasion in the conduct of inquiry* (pp. 35–57). Chicago: University of Chicago Press.
Metzger, W. (1987). The academic profession in the United States. In B. Clark (Ed.), *The academic profession* (pp. 123–208). Berkeley: University of California Press.
Moran, J. (2010). *Interdisciplinarity* (2nd ed.). London: Routledge.
Murray, H. & Renaud, R. (1995). Disciplinary differences in classroom teaching behaviors. In N. Hativa (Ed.), *Disciplinary differences in teaching and learning: Implications for practice* (pp. 31–40). San Francisco: Jossey-Bass.
O'Connor, K., & Yates, L. (2014). Disciplinary representation on institutional websites: Changing knowledge, changing power? *Journal of Educational Administration and History, 46*(1), 1–16.
O'Neill, A., & Meek, V. L. (1994). Academic professionalism and the self-regulations of performance. *Journal of Tertiary Education Administration, 16*(1), 93–107.
Repko, A. F. (2008). *Interdisciplinary research: Process and theory*. Los Angeles: Sage.
Salter, L., & Hearn, A. (1996). *Outside the lines: Issues in interdisciplinary research*. Montreal: McGill-Queen's University Press.

Sarewitz, D. (2010). Against holism. In R. Frodeman, J. T. Klein, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 65–75). Oxford: Oxford University Press.

Shulman, L. S. (2002). Foreword. In M. Taylor Huber & S. P. Morreale (Eds.), *Disciplinary styles in the scholarship of teaching and learning: Exploring common ground* (pp. v–ix). Menlo Part: American Association for Higher Education.

Smith, R. (2016). Building 'applied linguistic historiography': Rationale, scope and methods. *Applied Linguistics, 37*(1), 71–87.

Strathern, M. (2004). *Commons and borderlands: Working papers on interdisciplinarity, accountability and the flow of knowledge*. Oxford: Sean Kingston Publishing.

Strober, M. H. (2006). Habits of the mind: Challenges for multidisciplinary engagement. *Social Epistemology: A Journal of Knowledge, Culture and Policy, 20*(3–4), 315–331.

Strober, M. H. (2011). *Interdisciplinary conversations: Challenging habits of thought*. Stanford: Stanford University Press.

Suchman, L. (1994). Working relations of technology production and use. *Computer Supported Cooperative Work, 2*, 21–39.

Trowler, P. (2014). Depicting and researching disciplines: Strong and moderate essentialist approaches. *Studies in Higher Education, 39*(10), 1720–1731.

Turner, S. (2000). What are disciplines? And how is interdisciplinarity different? In P. Weingart & N. Stehr (Eds.), *Practicing interdisciplinarity* (pp. 46–65). Toronto: University of Toronto Press.

Widdowson, H. (2000). On the limitations of linguistics applied. *Applied Linguistics, 21*(1), 3–25.

Ylijoki, O.-H. (2000). Disciplinary cultures and the moral order of studying: A case study of four Finnish university departments. *Higher Education, 39*(33), 339–362.

3

Understanding Interdisciplinarity

Introduction

'Interdisciplinarity', argues Frodeman (2010: xxxi) in possibly the most general but also the most engagingly profound characterisation of the term, 'represents the resurgence of interest in a larger view of things.' Broadly conceived, this points to a shift away from elevating the pursuit of disciplinary goals as ends in themselves and towards an engagement with broader responsibilities to society. The growth of interdisciplinarity, therefore, involves more than the development of a different form of research engagement; it also represents a challenge to traditional academic structures and priorities. While the general impact of this important reconfiguration is not the concern of this book, it is nevertheless important to situate attempts to characterise interdisciplinarity within this wider context.

The aim of this chapter is to develop a clear picture of what the development of interdisciplinarity represents for those involved in interdisciplinary research and to suggest how our understanding of this might be deepened. This will involve first of all a very brief overview of the history of interdisciplinarity, responding to Barry et al.'s (2008) caution against

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treating it as a historically novel phenomenon. A working definition of the term will then be developed, highlighting some of the different representations that have contemporary currency and identifying the issues they raise. This will then form the foundation for considering typologies of interdisciplinarity that have been proposed and using these as a means of exploring its many dimensions. The description developed here will form a background to the analysis in the chapters that follow, where the focus is on the nature of interdisciplinary engagement.

A Brief History of Interdisciplinarity

In deciding on the roots of interdisciplinarity much depends on how loosely one interprets the term. Moran, for example, traces it back to the work of the Renaissance scholar Giambattista Vico, whose *De Ratione* set out to compare ancient and modern learning and proposed that students should be exposed to both the arts and the sciences as part of a broad curriculum. His much better known *Scienza Nuova* represented a radical departure from conventional thinking, and in advancing the case for the human sciences he might reasonably be seen as proposing a synthesis that implies an interdisciplinary orientation, but this falls short of the 'advocacy of interdisciplinary study' that Moran (2010: 7) ascribes to him. While Vico's approach and others like it might be broadly in sympathy with an interdisciplinary orientation, they are not responses to the sort of broader societal and intellectual forces that could have shifted them into the mainstream, so instead they remain interesting precursors to a movement that did not take tangible shape until the twentieth century and is only now gathering significant momentum.

Klein (2005: 33), in her rich discussion of the concept of interdisciplinarity in the context of the development of the humanities, draws an important distinction between its philosophical grounding, which can be traced to ideas current in the ancient world, and its emergence as an approach which represented a practical response to what she describes as a 'pathological condition': the challenges of the modern world and proliferating specialisation. She points out (2005: 2) that the term itself did not emerge until the twentieth century and identifies a number of accounts of the development of the practice, the earliest being in the 1920s with the Social Science Research Council's use of the term to refer to research crossing more than one of its divisions. Interdisciplinarity is, as Salter and Hearn note (1996), an essentially twentieth-century phenomenon and although there seems to be no general agreement on the precise coordinates of its developmental trajectory, the emergence of new fields such as ecology, biotechnology and molecular genetics after the mid-century are testament to its firm presence on the academic scene.

The appearance of these fields needs to be seen in the context of new challenges and opportunities that exposed the 'pathological condition' identified by Klein and revealed the limitations of traditional disciplinary resources. Interdisciplinary alternatives offered better prospects of success not only in engaging with complex, sometimes urgent, challenges but also in exploiting new opportunities or meeting new research needs. They also respond to subtle but profound changes in the epistemological landscape, as summed up by Wiesemes and Karanika-Murray (2009: 3):

> The focus on interdisciplinary research is perhaps a by-product of a shift in the way that knowledge is produced. The hierarchical, homogeneous mode of disciplinary work and certification is being replaced by one characterised by complexity, hybridity, heterogeneity, and transdisciplinarity.

There are a number of specific factors that can be identified as contributing to the growing demand for interdisciplinary research:

- New problems needing to be addressed
- New lines of research demanding wider approach
- New technologies opening up fresh possibilities
- Shifts in the intellectual landscape giving rise to new questions and new demands
- Major challenges confronting society, such as HIV/AIDS

In fact, with the exception of the last, in many cases the emergence of interdisciplinarity involved the confluence of more than one of these factors. The US National Academy of Sciences (2005: 17), for example, notes that many of today's 'hot topics' are interdisciplinary, citing as examples nanotechnology, genomics and proteomics, bioinformatics, neuroscience, conflict, and terrorism; and while the last is clearly a response to a specific challenge, the others all involve more than one element from the above list. The Academy's (2005: 30–39) list of four challenges driving interdisciplinary research maps onto the list above but also includes a broader category, the inherent complexity of nature and society. Since this is likely to increase, the likelihood of further expansion in interdisciplinary research in the future must be considerable.

An element that has been omitted from the above list is the increasing interest of governments and funding bodies in the demonstrable impact of research and an associated willingness to encourage interdisciplinary projects by using financial incentives. While some (e.g. Barry et al. 2008) argue that the link between impact and interdisciplinarity should not be overplayed because preoccupations with accountability have to be seen in the context of other dynamics, from a researcher perspective a powerful motivation for doing interdisciplinary research is its potential for practical application (Blackmore and Kandiko 2011).

It is perhaps premature to claim, as Weingart and Stehr (2000: 11) do, that 'the organizational matrix of disciplines is beginning to dissolve' with the emergence of interdisciplinarity, and it is also difficult to square this with their later reference (2000: 43) to the lack of any systematic empirical evidence of changes in the disciplinary landscape. Nevertheless, the importance of interdisciplinary team science in the academy makes it vital that we understand the workings of what has been described as 'the defining feature of the scientific endeavor in the twenty-first century' (Kessel and Rosenfield 2008: ix).

Definitions

Interdisciplinarity is at best an elusive concept (Boix Mansilla 2005: 16), though given its wide range the value of it may lie to some extent in its flexibility and indeterminacy (Moran 2010: 15), its 'ambiguity' (Richards 1996: 117) notwithstanding. There is certainly no shortage of definitions on offer, and Lattuca (2001: 10–14) provides a useful overview of the development of these, which began in the 1930s and peaked in the 1970s and 1980s. There have also been attempts to establish criteria for assessing the extent to which a project can be described as interdisciplinary, some of them very specific. Birnbaum (1977), for example, not only identified the more obvious criteria such as the application of different bodies of knowledge and different problem-solving approaches to a common problem, but also specified more contentiously that group members should share common facilities and be influenced by how others performed their tasks.

The aim of this section, however, is not to offer a critical evaluation of the many definitions on offer but rather to develop a characterisation of the approach that will provide an adequate foundation for understanding the framework within which the activities analysed in this book are to be understood. In order to do this it will consider some core definitions and the issues they raise but begin and end with the perspectives of those involved.

A natural starting point for any definition must be the discipline since whatever form interdisciplinarity might take it must involve the coming together of two or more disciplines, and this in turn requires engagement by those involved, producing the most basic of the definitions on offer. Jacobs and Frickel (2009: 43), for example, define interdisciplinarity in precisely these terms as 'communication and collaboration across disciplines'. Interestingly, these two elements are also the ones that interdisciplinary practitioners identify as characterising their work. Having first conducted an extensive analysis of interdisciplinary papers, Aram (2004) interviewed 12 participants in humanities and social sciences to discover that they were equally divided in terms of how their definition could be characterised: while six focused on the fusion of knowledge, the remainder highlighted the importance of dialogue or borrowing.

A similar approach was adopted by Aboelela et al., who reviewed 500 papers related to interdisciplinarity and interviewed researchers in order to produce a preliminary definition that they then tested on 12 experienced interdisciplinary researchers. This enabled them to identify key definitional components and on the basis of these propose a definition of interdisciplinary research (2007: 341):

> Interdisciplinary research is any study or group of studies undertaken by scholars from two or more distinct scientific disciplines. The 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.

A comparison of this with the two definitions of the term that are quoted most widely by researchers in the field of interdisciplinarity reveals a clear alignment with the more recent of the two:

> Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice. (National Academy of Sciences 2005: 2)

> 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. (Organization for Economic Cooperation and Development (OECD) 1972: 25–26)

Although the definition developed by Aboelela et al. refers to projects rather than making the somewhat stronger claim found in the National Academy of Sciences definition that interdisciplinary research is a 'mode of research', and although the former makes no reference to the purpose of such research, they both agree on the crucial point that interdisciplinarity involves *integration*. This element is to be found in the Organization for Economic Cooperation and Development (OECD) definition, but significantly it occurs as one end of a continuum that has 'simple communication' at the other end.

This distinction is an important one insofar as it reflects a fundamental difference in perspective that is to be found in virtually all definitions of interdisciplinarity. While all include reference to the involvement of two or more different disciplines, some focus on integration, often mentioning the elements that are brought together and sometimes even going as far as Aboelela et al. by referring to a shared conceptual model (the National Institute of Health definition with which they begin, for example, refers to 'a true meeting of minds'); others, however, place much greater emphasis on the interaction between the disciplines and the researchers involved. For this reason, it seems reasonable to divide definitions into those that are essentially *integrationist* and those better described as *interactionist*, the latter offering a more specific characterisation than that provided by Repko's (2007) distinction between integrationist and generalist.

As well as reflecting positions of academics involved in interdisciplinary work, this distinction is to be found in even the most basic definitions offered by those researching interdisciplinarity. Some writers (e.g. Lattuca 2001; Strober 2011) prefer to use the term 'interdisciplinary' in the most general sense possible, as a 'spectrum' (Barry et al. 2008: 27) covering any situation involving more than one discipline whatever the level of engagement, from the most basic collaboration to complete integration. Moran's interactionist definition provides a good example of this:

> Within the broadest possible sense of the term, I take interdisciplinarity to mean any form of dialogue or interaction between two or more disciplines: the level, type, purpose and effect of this interaction remain to be examined. (Moran 2010: 14)

Others forge their general definitions from different materials. There is no reference to interaction, for example, in what may be the shortest definition on offer, which adopts a comprehensively integrationist perspective: 'the integration of disciplines within a research environment' (Qin et al. 1997: 894).

The eighth of Salter and Hearn's (1996: 7) nine myths of disciplinarity is that interdisciplinary research always involves team research. As they point out, it is possible for an individual researcher to draw on different disciplines and in so doing engage in interdisciplinary research. Technically this is true, and it is interesting to note that the National Academy of Sciences definition is careful to refer to 'teams or individuals'. While this makes an interactionist position potentially problematic, it could be argued that the dialogue could as well be internal as external, just as criticisms of integrationist definitions invite the riposte that integration has many dimensions.

These two positions are best seen as matters of emphasis or perspective rather than oppositional alternatives and the quality of interdisciplinary research is likely to depend largely on the ways in which disciplinary engagement—at intellectual, practical and potentially interpersonal levels—is negotiated. It is therefore important to develop an understanding of the mechanisms involved in this.

Forms of Interdisciplinarity

Interdisciplinary form will be influenced by a number of factors, and the aim of this section is to identify the dimensions that are most relevant to the organisation of these. In order to do this it draws on different categorisations of interdisciplinary form that have been proposed, showing how these relate to one another as part of a larger picture.

The most important factor is likely to be the nature of the disciplines involved and the relationship between them. This makes it useful to bear in mind the distinction drawn by Klein (2005: 63) between 'narrow interdisciplinarity', where the disciplines involved have compatible methods, epistemologies and so on and 'broad interdisciplinarity', where there is no such compatibility (e.g. sciences and humanities). In broad interdisciplinarity, for example, research is not likely to be located at the intersection of two disciplines and is more likely to be driven by the need to address a specific problem that has many dimensions, whereas in narrow interdisciplinarity it is possible to undertake research across the boundaries of related disciplines (for a fuller list of options, see Bammer 2013: 7).

This division is a useful one, but it represents the disciplinary relationship in its broadest terms and leaves open the possibility of many different relational configurations. Neither term, for example, captures the situation where different disciplines work together in a defined interdisciplinary field of study, often with its own designation, as part of the process of evolution towards recognition as a discipline in its own right. Systems biology is an example of a field of study that seems to be recognised as an 'interdiscipline' but has not yet achieved full disciplinary status, whereas biochemistry followed a similar trajectory and achieved disciplinary status some time ago. While Klein (2010: 22) is surely right to claim that it is unwise to assume that today's interdiscipline is tomorrow's discipline, the existence of interdisciplines and stable interdisciplinary research groupings make it worth extending Klein's distinction to include 'focused interdisciplinarity', where the bonds are stronger than those in narrow interdisciplinarity.

These distinctions would be transcended by some of the more radical reconfigurations that have been associated with interdisciplinarity, such as the sort of methodological shift that Krohn (2010: 32) claims to have identified. He argues that interdisciplinary research 'constitutes' a relationship between individual cases and more general knowledge bases than is characteristic of disciplinary approaches. This, he argues, calls for a new mode of knowledge that would see learning about a case as just as legitimate as understanding causal structures, an approach that would support 'a critical reassessment of the received concept of scientific law and exemplary application'.

At the furthest extreme from such radical realignments are the various forms of interdisciplinary engagement that help nurture a culture of interdisciplinarity without themselves representing a formal commitment to it. A useful distinction that emerged from Lattuca's (2001) interviews with faculty who had engaged in interdisciplinary scholarship was that between formal and informal activities. The former were defined by respondents as involvement in interdisciplinary teaching or research on either an individual or collaborative basis. Informal activities, on the other hand, involved participation in activities outside the home discipline (as defined by the respondent) such as interdisciplinary workshops, conferences or colloquia. In view of this, Lattuca favours the OECD definition quoted above because this focuses on interaction, which she takes to be a broader notion than collaboration or team research, suggesting a continuum from informal communication to formal collaboration.

In formal collaboration a relationship will be forged between the disciplines involved, and this may be influenced by a number of factors including disciplinary status, demands of the project and the nature of team membership. Barry et al. (2008) undertook an 18-month comparative empirical study of interdisciplinary research institutions and initiatives involving natural sciences/engineering and social sciences/arts/humanities. Their aim was to gain a sense of the multiplicity of interdisciplinary forms in these institutions, and their work was in part informed by that of Nowotny (e.g. 2003), which identified a shift to new forms of knowledge production and quality control undermining traditional disciplinary boundaries and marking a change from a culture of autonomy to one of accountability. They identified three logics influencing interdisciplinary form: accountability, innovation and ontology, the last of these referring to the power of interdisciplinary collaboration to generate new ways of thinking about the nature of the disciplines involved. The engagement of these logics produced three different modes of interdisciplinarity identified by the authors (for a fuller discussion of these, see Barry and Born 2013: 10–13):

Integrative-synthesis—The combination of two or more disciplinary components or the synthesis of these in relatively symmetrical form.
Subordinate-service—One or more disciplines have a subordinate or service role with respect to others.
Agonistic-antagonistic—Driven by an antagonistic or agonistic relationship with existing forms of disciplinary knowledge or practice. The authors argue that this mode can be understood only in terms of establishing a new ontology to supersede previous ones.

While the relationship between disciplines will exert a strong influence on interdisciplinary form, the extent to which they are integrated will be an equally powerful determinant. While it might be tempting to view integration in terms of a continuum, the fundamental distinction between those projects seeking only conceptual alignment (e.g. in order to solve a problem) and those working towards conceptual synthesis makes such a model inappropriate. Instead, a distinction of the sort proposed by Salter and Hearn (1996) between instrumental and conceptual models is required. What makes this description particularly worthy of note is a further distinction they draw that has not only epistemological but political implications.

Salter and Hearn (1996: 30) argue that in instrumental interdisciplinarity, 'no overall synthesis of concepts or analyses is attempted; no fusion of different perspectives toward the creation of new knowledge is fully tried.' Instead, existing frameworks are temporarily integrated for the purpose of solving a specific problem. In one form of conceptual interdisciplinarity, concepts are synthesised but the importance of the disciplines for effective interdisciplinarity is recognised and there is no overt critique of disciplinarity as such. However, this is not the case in the second form:

> In this second view, there are two further alternatives to the disciplinary organization of knowledge proposed. The first alternative advocates a form of transdisciplinarity – the search for a unity of knowledge. The second alternative is critical of disciplinarity and the ideal of unity, and it proposes, through interdisciplinarity, a form of politicized transformative knowledge. (Salter and Hearn 1996: 31)

This second alternative refers to a position that sees interdisciplinarity not in terms of branches of knowledge but as forming part of a more general critique of academic specialisation. Moran (2010), for example, sees it as challenging the status of the disciplines and highlighting as problematic their claims to scientific objectivity and neutrality, while Lattuca (2001) points to similar challenges to claims of epistemic legitimacy advanced by feminists and postmodernists, who highlight the power distortions and the associated marginalisation of some groups inherent in disciplinary structures. In fact, some advocates of an interdisciplinary approach argue that because this results in a more equitable distribution of power it therefore offers more legitimate routes to understanding and equality.

This may not be a widely held position, and there are those (e.g. Jacobs and Frickel 2009) who are sceptical about the theoretical and empirical basis of such claims, doubting whether interdisciplinarity will advance the integration of knowledge, but it is part of a wider debate about the status of the disciplines in the context of the growth of interdisciplinarity and the extent to which the latter represents an existential threat (for an excellent summary of the debate, see Jacobs and Frickel 2009, drawing on Abbott 2001 and Whitley 1984). There is, in fact, clear evidence of a shift in the twentieth century, identified by Lattuca, away from interdisciplinarity as an instrumental response motivated by a need to solve problems and towards a more critical stance that makes a case for privileging this approach. As a result of this evolutionary process, she argues, interdisciplinarity 'has outgrown its own definition' (Lattuca 2001: 4).

This critical turn may yet take interdisciplinarity—and its definitions—in new directions, but the four relational dimensions identified in this section are likely to remain important influences on its form:

Disciplinary distance:	narrow, broad (Klein), focused
Disciplinary relationship:	integrative-synthesis, subordinate-service, agonistic-antagonistic (Barry and Born)
Epistemology:	instrumental, conceptual (Salter and Hearn)
Engagement:	formal, informal (Lattuca)

While this provides a general characterisation of interdisciplinarity relevant to its definition, more formal typologies have been proposed, making important distinctions between different forms of 'interdisciplinary' research. The following section provides a preface to this by considering three key terms.

Interdisciplinary, Multidisciplinary and Transdisciplinary

According to Klein (2010: 15), the first major interdisciplinary typology was published in 1972, and despite subsequent proliferation there is general agreement on the core terms, *interdisciplinary*, *multidisciplinary* and *transdisciplinary*. This section distinguishes these as a basis for considering deeper issues in interdisciplinarity as revealed in some of the main typologies that have been proposed.

What follows will be based on arguments advanced by those for whom interdisciplinarity is an object of research, and it is perhaps worth setting this in perspective by noting that their terminology does not seem to concern those involved in interdisciplinary research itself. Basing his claim on questionnaires, interviews and focus groups with 65 academics involved in interdisciplinary research, Darbellay (2015: 167), for example, reports that 'beyond the seemingly obvious use of the terms inter- and trans-disciplinarity in a given community of researchers – we confirmed that these conceptual tools are not systematically discussed, negotiated and co-defined in the context of the communicational interaction of the research group'. Lattuca (2001: 71) undertook similar research with similar results: 'What one informant labeled as interdisciplinary was dismissed by another as merely multidisciplinary or even disciplinary.'

Multidisciplinarity and Interdisciplinarity

The most basic distinction is that between multidisciplinarity and interdisciplinarity. The former draws on different disciplinary perspectives, but each discipline maintains its own distinct identity and no attempt at integration is made. As Stokols et al. (2010: 474) put it, participants in multidisciplinary teams 'remain firmly anchored in the concepts and methods of their respective fields'. For this reason, some researchers (e.g. Strober 2006, 2011) have treated the term as synonymous with 'cross-disciplinarity' and multidisciplinary research has also been referred to as pluridisciplinarity (Darbellay 2015). Such research allows participants to work relatively independently, engaging in little cross-fertilisation. Hence, 'multidisciplinary research involves low levels of collaboration, does not challenge the structure or functioning of academic communities or hierarchies and does not lead to any changes in the worldviews of the researchers themselves' (Lyall et al. 2011: 13).

The fundamental distinction between this form of research and interdisciplinary research is that the latter involves the integration of at least some aspects of the different disciplines involved, whether it be in terms of method, content or theory. The nature and extent of the integration may vary, but Petrie (1976) drew a simple but useful epistemological distinction that pins down the essential difference between the two forms of research: while in multidisciplinary projects it is possible for a researcher to complete their part of the whole without needing to understand the work of collaborators, interdisciplinary research depends on participants taking into account the contributions of others in order to make their own contribution. This fits in well with Berger's (1972: 25) requirement of 'continuous intercommunication' between the representatives of different disciplines and is consistent with the claim of Huutoniemi et al. (2010: 85) that a large majority of interdisciplinary research is epistemologically oriented, depending on a degree of boundary crossing for its success.

Some researchers have taken the broad distinction between the two approaches and broken these down into different forms (see, for example, Huutoniemi et al. 2010: 83), while others have characterised the distinction between them in slightly different terms, but in all cases the notion of integration is always at least implicit. Rowe (2008: 4), for example, distinguishes interdisciplinary from multidisciplinary research on the basis that in the former approaches are applied simultaneously over a significant period of time, rather than sequentially, though it is hard to see how length of time would serve as a distinguishing factor.

Repko's (2007) is a more straightforward case. He draws a distinction in terms of common ground, contrasting the placement of disciplines side by side in multidisciplinarity with the establishment of common ground that is characteristic of interdisciplinarity. However, this is part of a broader argument in which he draws on the work of cognitive psychologists to establish that integration is not only a defining characteristic of interdisciplinarity but that in practical terms it is both achievable and assessable.

Transdisciplinarity and Interdisciplinarity

Transdisciplinarity has been described as '[t]he greatest departure from a discipline base' (Lyall et al. 2011: 14), raising more complex and fundamental issues than those associated with multidisciplinarity. While there seems to be general agreement that transdisciplinarity involves a greater degree of integration than does interdisciplinarity, interpretations of the term range widely, and it is worth bearing in mind that these are indigenous concepts, the latter associated with the Anglo-American academy and the former being more prevalent in French and German contexts (Barry and Born 2013). Strober's memorable culinary metaphor offers perhaps the most striking characterisation of transdisciplinarity:

> Using a culinary metaphor, a disciplinary dish consists of only one food—a potato, for example. If we add steamed carrots and sautéed peas to the potato, we have a multidisciplinary or cross-disciplinary dish. For the dish to be interdisciplinary, the vegetables have to be integrated, cooked together into a soup or tossed into a salad. To become transdisciplinary, the individual ingredients would have to be no longer identifiable; for example, if all of the cooked ingredients for a soup were put through a blender, we would have a transdisciplinary soup. (Strober 2011: 16)

This picture of a 'transdisciplinary soup' is consistent with Strober's claim elsewhere (2006: 319) that in transdisciplinary research it is difficult to identify distinct disciplinary traits, though this is not a characteristic that is generally highlighted, at least in such an extreme form. The features identified by Aboelela et al. (2007: 340) offer a more mainstream characterisation in which the relevant problem is situated in a new theoretical (or linguistic) context that is broader than any single discipline and the methods are fully synthesised, to the extent that they may in time result in a new field.

While boundary transgression is typically associated with interdisciplinarity, transdisciplinarity is often seen as transcending disciplinary divisions, which implies a status that has structural implications. Darbellay (2015: 166), for example, argues that one of the two 'major and complementary orientations' of transdisciplinarity involves an epistemological reorientation that not only transcends disciplinary boundaries but also 'entails a major reconfiguring of disciplinary divisions within a systemic, global and integrated perspective'. His second orientation, which features the involvement of a range of participants from outside the relevant scientific field, is more contentious but conveys a sense of the radical realignment of priorities that is often associated with this approach. In this respect, there are parallels to be drawn between transdisciplinarity and the critical form of interdisciplinarity, which challenges the academic status quo. If there has indeed been a marked shift towards this position in debates on interdisciplinarity, distinctions between the two categories may over time become increasingly blurred.

Alternative Formulations

While *multidisciplinary, interdisciplinary* and *transdisciplinary* are likely to remain standard points of reference for some time to come, a number of researchers prefer to use 'interdisciplinary' as a general term because of the lack of clear boundaries between them, a position that is taken up in this book. Extensive typological work over the last half century has produced a plethora of descriptive terms applying to these approaches, and alternative models have been proposed that can be mapped onto the basic tripartite distinction but are more precisely delineated.

Van Leeuven (2005) serves as a useful illustration of one such alternative. He identifies three 'models' of interdisciplinarity: *centralist*, *pluralist* and *integrationist*, categorising these in terms of the relationships between the disciplines involved and the relevant research orientation. In a centralist model, for example, the disciplines involved remain autonomous so that 'each discipline sees itself as the centre of the universe of knowledge, and, from this centre, charts its relations to other disciplines' (2005: 3). Disciplines cleave to their own theories and methods, so relations with other disciplines chiefly concern overlapping subject matter.

Pluralist models are characterised by a focus on issues and problems, which are recognised as being shared by more than one discipline. For this reason, the disciplines involved engage as equal partners working on common ground, rather than merely incorporating selected elements as would be the case with centrist models. Nevertheless, the disciplines themselves remain autonomous and operate self-sufficiently, maintaining their distinct identities and fundamental values. In pluralist models it is assumed that each discipline can address the shared problem on its own, whereas in an integrationist model this degree of autonomy is not possible and the disciplines are seen as interdependent, with research based on integrative principles that require teamwork, a division of labour, and so on. As van Leeuven notes, this involves a major shift in the way that disciplines function, representing a challenge to the status quo.

It is clear from this brief summary that van Leeuven's models map comfortably onto the standard categorisation, marked by a shift from autonomous cooperation, through collaborative engagement to full synthesis, and in such cases it is perhaps as well to rely on the standard nomenclature in order to avoid adding to the plethora of terms that is reflected in typological work in this area.

Typologies and Models

In the more than half century since the publication of the first interdisciplinary typology, there has been no shortage of attempts to represent the field in all its diversity—producing a very complex picture that can be more confusing than enlightening. Klein's (2010: 16) table, 'defining characteristics of typologies of interdisciplinarity' gives some sense of this in terms of both its layout and content. Headed by the standard terms 'multidisciplinarity', 'interdisciplinarity' and 'transdisciplinarity', it includes degrees of integration and embraces distinctions such as methodological and theoretical, bridge building and restructuring, and endogenous and exogenous. These are laid out in order to bring out the relationships amongst them, but the complexities of the field of necessity produce an arrangement that requires careful negotiation.

The aim of this section is not to propose a similar categorisation of typologies or to attempt an overview of the many alternatives available, but to select a few key examples in order to illustrate how this work both extends the basic distinctions drawn in the previous section and highlights issues in interdisciplinary research. In order to do this it will follow Huutoniemi et al.'s (2010: 81) summary of ways in which interdisciplinary research has been categorised. The authors identify three focuses of interest: degrees of disciplinary integration, interdisciplinary practices and rationales of interdisciplinarity. Since rationales were considered in the previous section in addressing what might be called the primary categories, only the first two will feature here.

Integration

Although Repko (e.g. 2007, 2008) is arguably the most enthusiastic proponent of integration, this section focuses on the work of Lattuca (2001), who developed her typology on the basis of interviews with 38 academics involved in interdisciplinary scholarship. Their approach to this form of research, she concluded, was no different from the way in which they thought about research design generally: allowing the problems or questions they were addressing to determine the methods they used, with different questions leading to different kinds of interdisciplinarity. Using this as her point of departure, she identifies four types, each associated with a particular form of question: informed disciplinarity, synthetic interdisciplinarity, transdisciplinarity and conceptual interdisciplinarity.

Informed interdisciplinarity draws on other disciplines (e.g. examples, theories, methods) but always in the service of a disciplinary question. This is based on questions requiring outreach to another discipline or disciplines; only when the question becomes interdisciplinary does the scholarship also count as interdisciplinary.

Synthetic Interdisciplinarity involves bridging disciplines. A question or issue may be found in the intersections of disciplines, in which case it belongs to both, or in the gap between disciplines, in which case it belongs to neither. The disciplines remain identifiable, though the questions cannot be answered completely by a single discipline. The example she gives is a question exploring the biological and psychological aspects of human communication.

Transdisciplinarity involves applying theories, concepts or methods across disciplines with the aim of developing an overarching synthesis. The theories, concepts or methods involved are not drawn from a particular discipline but transcend disciplines, which are subordinated to a larger framework (Klein 1990). Transdisciplinary research, Lattuca argues, is driven by a belief that natural and social systems share underlying structures or relationships, and transdisciplinary questions are applicable across disciplines, transcending a single disciplinary identity. Sociobiology is an example of this approach.

Conceptual interdisciplinarity embraces questions and issues with no disciplinary basis, which can be answered only by drawing on a variety of disciplines. Research questions associated with this, she argues, have no compelling disciplinary basis. She notes that this type often implies a critique of disciplinarity and offers as an example a project studying domestic roles in medieval England examining constructions of class and gender, drawing on contributions from history, political theory, literature, art history, philosophy, and religion.

In developing this typology, Lattuca claims that distinctions between multidisciplinarity, interdisciplinarity and transdisciplinarity are 'largely theoretical in nature' and 'difficult to apply to real projects' (2001: 246), noting that despite the efforts of researchers so far there is no foolproof method available for assessing the level of integration of a project. She nevertheless aligns her own terms with those used by other researchers (2001: 114) matching, for example, informed disciplinarity with instrumental interdisciplinarity, pseudointerdisciplinarity, cross-disciplinarity and partial interdisciplinarity.

In applying her own typology to research questions, Lattuca concludes that the issue is not one of the degree of interdisciplinarity, it is rather that the questions themselves are qualitatively different, requiring a new scheme for understanding interdisciplinarity. Although she rejects the idea that different types of disciplinarity can be arranged on a continuum, this does not necessarily apply to the experiences of participants, which might be ranged on a variety of continua such as the degree of formality involved in interactions and the frequency or intensity with which they engage in interdisciplinary activities. In this respect, her categorisation shifts towards Huutoniemi et al.'s third category: interdisciplinary practices.

Interdisciplinary Practices

In terms of studies quoted, this is the most extensive of Huutoniemi et al.'s three categories, perhaps understandably in view of the variety of possible arrangements. The two categorisations considered here are those most relevant to the research that follows. The first focuses on the participants involved in research and the second on the nature of the engagement involved.

On the basis of an examination of different structures and strategies of interdisciplinary science, Palmer (1999) identified four different researcher orientations, which she then mapped onto five research modes (approach, information practices, knowledge strategies, scope and outcome), producing a revealing picture of how different researchers approach interdisciplinary projects. The researcher orientations themselves are interesting, covering 'team leaders', who see themselves primarily as managers of other researchers in overseeing a number of projects, 'collaborators', who prefer to work with researchers from other domains, 'generalists', who prefer to work alone, and finally 'problem-oriented' researchers, who mix both approaches, working independently on some projects and cooperatively on others.

This diversity reveals why attempts to develop fixed procedures or steps for undertaking successful interdisciplinary research are unlikely to be successful (see, for example, Szostak 2002, and the response by Mackey 2002). However, Amey and Brown (2005) offer not a typology but a model based on their analysis of the development of an 18-month university-community partnership. Data collection involved observations of team meetings, interviews with participants, analysis of project documents and analysis of reflective papers by team members highlighting key decision points and noting perceptions of the group process. The final model is compromised to some extent by the fact that the final stage was not fully realised and is therefore hypothesised, but the changes identified as the project evolved provide an interesting insight into some of the relevant processes. The individual, single-discipline orientation of the first stage, characterised by competitive exchanges, for example, evolves into a more group-centred orientation in the second stage, marked by a growth in understanding of other disciplines, greater coordination and a shift away from competition to coexistence (a very similar trajectory to that proposed by MacMynowski 2007, from conflict to transformation, via tolerant ambivalence and cooperation and identification). At the same time, the mode of leadership shifts from a top-down approach to more facilitative and inclusive engagement.

While extrapolation from one project must be treated with a degree of caution, at least some of the changes noted here are likely to be detectable in other projects and at the very least these findings highlight the potential limitations of cross-sectional rather than longitudinal studies of interdisciplinary projects. Taken in conjunction with Palmer's categorisation of researcher orientations, they also point to some of the aspects of interdisciplinary research that bear on the success or failure of a disciplinary project. The following section will briefly consider other dimensions that are relevant to this.

Experiencing Interdisciplinarity

The literature on interdisciplinarity is now extensive and covers aspects that, although important, are not directly relevant to the research in this book. The development and even success of interdisciplinary research, for example, will be influenced by its institutional context, which makes organisational studies of this (e.g. Sa 2009) important. Holley (2009), drawing on case studies of 21 research universities in the United States, highlights the importance of cultural as well as structural dimensions in promoting interdisciplinarity at the institutional level, while Strober (2006), in her report on the outcomes of differently constituted cross-disciplinary seminars in three different institutions over two years aimed at developing interdisciplinary conversations, laments the failure at institutional level to follow up on many of the opportunities these generated. In addition to broader contextual factors such as these, there are also specific aspects and outcomes of interdisciplinary research that fall outside the scope of this study, an obvious example being the development of suitable frameworks for assessing the quality of research outputs (see, for example, Belcher et al. 2016). Also excluded from consideration here are the many aspects of interdisciplinary teaching, curricula, and so on that are part of a wider picture but only tangentially associated with research.

The focus in this book is on interdisciplinary interaction, which, as the next chapter will argue, is a crucial but inexplicably neglected aspect of the process of interdisciplinary research. While an understanding of this will inform decisions at the institutional level and may throw light on current approaches to the evaluation of interdisciplinary research, neither of these feed into the analysis itself. However, an appreciation of what is known about the experience of being an interdisciplinary researcher and of the factors that contribute to the success of interdisciplinary research will provide a useful backdrop to the research that follows.

Lattuca has explored in depth the experiences of interdisciplinary researchers, drawing on interviews with 38 participants (Lattuca 2001) and focusing in particular on two of these as contrasting cases (Lattuca 2002). What makes her work particularly relevant to this study is her claim (2002: 719) that 'to understand how faculty learn to do interdisciplinary work, we should study not only the cognitive processes that allow faculty to think interdisciplinary ideas, but also how that learning is accomplished through social interactions with others, with the tools of different communities of practice, and in a variety of contexts.'

As with entry into any unfamiliar situation, engaging for the first time in interdisciplinary work will necessarily involve learning how that work gets done by those involved, and Lattuca draws on the work of Lave and Wenger (1991) and the idea of apprenticeship because she sees it as a useful metaphor for learning. Lave and Wenger's concept of a community of practice emphasises the relational nature of knowledge and learning within professional groups, recognising that there will be different levels of participation and that this participation will take many forms. It could be argued that it would be more conventional to apply the model to disciplinary contexts, where groups are established and legitimate peripheral participation contributes to the process of socialisation, than to focus on interdisciplinary projects, where relationships might be more temporary and more likely to involve the establishment of a local research community rather than the induction of new members into it. However, Lattuca's analysis of interviews with the two researchers in her 2002 study, drawing on the concepts of mediation ('a process involving both the potential of cultural tools to shape action and the unique use of tools' p. 715), participation and apprenticeship, brings out the importance of the sort of relational aspects that are so important in Lave and Wenger's work.

Lattuca herself identifies some of the limitations of her wider study: Her selection was based on nominations by knowledgeable faculty and administrators, who may have overlooked or deliberately excluded some individuals; it relied on self-reports and did not examine documents or check these out in any way; and the selection was limited to those with doctorates in traditional liberal arts fields. She explains that the last of these was based on the assumption that these researchers would have stronger disciplinary views because professional fields such as business and education usually embrace a number of disciplines, but the absence of researchers from the physical sciences produces a picture that cannot be regarded as complete. Nevertheless, her research offers valuable insights into the experience of being an interdisciplinary researcher and teacher.

While the experiences of interdisciplinary researchers were influenced by institutional contexts, Lattuca cautions against placing too much stress on this and identifies a number of continua that influence the nature of the interdisciplinarity: the type of participation (formal and informal), frequency or intensity of engagement in interdisciplinary activities, the extent to which interdisciplinarity features in a researcher's body of scholarly work, and the degree of disciplinary outreach a teaching or research project entails. While these can produce different configurations, set against the experiential distinctiveness of interdisciplinarity is the fact that the processes involved in engaging in interdisciplinary work are largely similar to those involved in disciplinary work (Lattuca 2001: 250).

The two respondents in Lattuca's 2002 study came to interdisciplinarity by different routes: the first via a deliberate shift in his postdoctoral work during which he was funded to pursue work in different disciplines, the other as the result of attending meetings and then engaging with those from another discipline, leading to a period of 'apprenticeship' and growing knowledge of the discipline, though as Lattuca notes, academics following this route will not necessarily become full participants in their 'adopted' discipline. In fact, as Palmer (1999: 250) has pointed out, we still do not understand the level of knowledge necessary in order to undertake successful interdisciplinary research. On both routes, becoming interdisciplinary and engaging in interdisciplinary projects were cotemporaneous and interaction with relevant colleagues was important, leading Lattuca to emphasise the importance of relational aspects in the interdisciplinary landscape, a feature that will also emerge prominently from the analysis in the chapters that follow.

Lattuca's research also exposed a large element of serendipity in the ways in which academics came to interdisciplinarity, though the profile of her sample, with nearly half the participants having professorial status and assistant professors representing only 13% of the total, suggests that there might be a historical element in the picture presented. This needs to be offset, however, against Blackmore and Kandiko's (2011) finding that involvement in interdisciplinary research is more common in mid-career than at an early-career stage. Significantly, in both studies many participants found themselves isolated academically and often physically, which perhaps goes some way towards explaining their ambivalent relationship with their 'home' discipline, which was seen as providing a secure identity but could be constraining.

As opportunities for pursuing an interdisciplinary career from the outset increase, the conditions giving rise to such isolation will diminish, though there is some evidence that generational differences are making the process of transition a challenging one. For example, while attempts are now being made to develop interdisciplinary research skills in doctoral students (Lyall and Meagher 2012), Gardner et al.'s (2014) investigation of the socialisation of doctoral students into interdisciplinarity revealed a disturbing lack of connection between faculty advisors and their students that arose from the enculturation of the former into disciplinary affiliations. The 'suppleness' in the thinking of interdisciplinary students was in marked contrast to the more sclerotic attitudes of their elders, which was also to some extent in evidence in Lattuca's (2001: 232) study, where the need to maintain a disciplinary identity was strongly felt. The shift in orientation on the part of early-career researchers is also reflected in different motivations for undertaking interdisciplinary research, an example being their desire to contribute to societal benefits (Bridle et al. 2013: 23).

Such idealism may prove hard to sustain in an environment that encourages researchers to embark on academic careers but denies them the same opportunities as their discipline-based contemporaries. A stark example of this is provided by Lyall et al. (2011: 106), who relate the comments of a professorial head of school on the PhD students coming from an interdisciplinary capacity-building scheme in the United Kingdom. Although he rated them very highly, he admitted that he would be unlikely to hire them because priority would be given to individuals able to teach introductory courses in the relevant discipline. The authors point out that this is consistent with the findings of a survey by the National Academies (2005: 264–5) in the United States in which both individuals and university provosts identified promotion criteria as the greatest impediment to interdisciplinary research. Within the interdisciplinary context itself there may also be power differentials that for researchers from some disciplines will serve only to add to the demands made on them. MacMynowski (2007: 5) sums up the situation with disturbing clarity:

> A deep normative current persists that valorizes mathematics and physics as the objective scientific ideal and views other research, particularly the in [*sic*] social sciences, to be trailing behind in the quest for rigor and valid knowledge… Accordingly, many of the social sciences, with their overt recognition of subjectivity on the part of the researcher, bring less social power to the interdisciplinary meeting ground than biophysical sciences.

The negotiation of the relationship between the demands of interdisciplinary work and those of mainstream research in general is likely to require careful positioning work on the part of those involved. Felt et al. (2013: 518) introduce the concept of 'epistemic living spaces' in addressing how researchers see their room for epistemic and social manoeuvre within research. Their work explores the possibilities and limits of contemporary research structures to accommodate alternative ways of producing knowledge within a 'transdisciplinary knowledge regime' and in doing so highlights the importance of epistemic space and the occupation of this, a topic that will be taken up later in this book.

Factors Influencing Interdisciplinary Success

Approaches to representing factors that contribute to interdisciplinarity take various forms and differ in scope, some researchers organising them into individual, project-based and contextual (e.g. Rowe 2008: 5–7), some focusing largely on practical considerations (for an example of this in terms of conditions producing a 'critical mass', see Klein 2005: 78), and others adopting more developmental models seeking to show how one set of relevant factors will feed into the development of another (e.g. Lyall et al. 2011). Different though the approaches are, a number of key elements can be identified and these are summarised below. Though the list is not intended as exhaustive and focuses only on interdisciplinary research, excluding teaching, it serves at least as a reminder of the many forces bearing on interdisciplinary engagement:

Contextual:	Adequate economic and symbolic capital (Klein 2005: 78)
	Institutional support structures
	Availability of external funding
	Adequate career opportunities
Intellectual:	Conceptual foundations for developing new knowledge
	Basis for establishing common ground
	Complementarity of skills and knowledge
	Ability to assess quality of outputs
(Inter)Personal:	Group-centred orientation
	Ability to establish a common language
	Mutual respect
	Willingness to engage with different perspectives

It is interesting to compare this rather general list with the views of those actually involved in interdisciplinary work. The interviews conducted by Aboelela et al. (2007: 334) produced a list that provides support for Lattuca's view that the processes involved in interdisciplinary research are for the most part similar to those in disciplinary work, covering 'respect for the scientific process and importance of collaborative research; identifying interesting topics; management, focus, and editing of work; and the ability to make mistakes gracefully'. In some ways the most interesting item on the list is the last, with its implicit recognition of the relational aspects of such work. The fact that 'graceful' might be interpreted in any number of ways is far less important than its orientation towards the other. Ultimately, success or failure may depend on how well members of such groups work together, and the demands made on members should not be underestimated:

> …each participant in interdisciplinary collaborations must value diversity, develop the capacity for self-assessment, work towards understanding one's own disciplinary culture, and be sensitive to the dynamics inherent when cultures interact. Additionally, members of any interdisciplinary endeavour must be cognizant of power dynamics at play and avoid such things as tokenism, informal hierarchies, and disciplinary policing. Through awareness of

> one's own disciplinary culture and sensitivity to others, interdisciplinary research and practice may provide creative solutions to important problems. (Reich and Reich 2006: 51)

This daunting list represents what might be seen as a counsel of perfection in the face of the considerable intellectual, interpersonal and interactional demands arising from the epistemic diversity inherent in interdisciplinary research. Anderson (2013) suggests that this factor in interdisciplinary research intensifies previously identified essential tensions in academic work more generally, while for Turner et al. (2015: 655) epistemic diversity has to be seen as one of three sets of interplaying tensions, the others being structural and affective. Structural tensions are essentially institutional, arising from the need for new organisational structures that are able to encompass a plurality of perspectives while also accommodating more conventional disciplinary departmental structures, while affective tensions arise from the creative challenges of engagement with scholars from other disciplinary backgrounds set against the reassurance of a unified academic community. These challenges align broadly with three of the four categories identified by Haythornthwaite et al. (2006): bridging practices, seeing and crossing boundaries, and managing external relations.

The chapters that follow make no attempt to engage with the full multiplicity of factors bearing on the success of interdisciplinary research but take as their focus its core feature: the group. Important as other considerations are, it is generally acknowledged that the construction of shared knowledge is at the heart of the disciplinary enterprise, and this in turn means that interpersonal relationships and social interaction are fundamental to its success (see, for example, Creamer 2005: 44). In spite of this, the importance of interaction in the interdisciplinary process has served more by way of a touchstone than as an object of serious enquiry. Unsurprisingly, then, McCallin (2001: 425) concluded a literature review of interdisciplinary teamwork in healthcare by noting that that '[m]ore research is needed to provide empirical evidence, grounded in practice, of the processes which teams use as they work and interact together.' Chapter 4 sets the scene for a response to this call.

References

Abbott, A. (2001). *Chaos of disciplines*. Chicago: University of Chicago Press.

Aboelela, S. W., Larson, E., Bakken, S., Carrasquillo, O., Formicola, A., Glied, S. A., Haas, J., & Gebbie, K. M. (2007). Defining interdisciplinary research: Conclusions from a critical review of the literature. *Health Services Research, 42*(1 Part I), 329–346.

Amey, M. J., & Brown, D. F. (2005). Interdisciplinary collaboration and academic work: A case study of a university partnership. *New Directions for Teaching and Learning, 102*, 23–35.

Anderson, H. (2013). The second essential tension: On tradition and innovation in interdisciplinary research. *Topoi, 32*(1), 3–8.

Aram, J. (2004). Concepts of interdisciplinarity: Configurations of knowledge and action. *Human Relations, 57*(4), 381.

Bammer, G. (2013). *Disciplining interdisciplinarity: Integration and implementation sciences for researching complex real-world problems*. Canberra: Australian National University E Press.

Barry, A., & Born, G. (2013). Interdisciplinarity: Reconfigurations of the social and natural sciences. In A. Barry & G. Born (Eds.), *Interdisciplinarity: Reconfigurations of the social and natural sciences* (pp. 1–56). Oxford: Routledge.

Barry, A., Born, G., & Weszkalnys, G. (2008). Logics of interdisciplinarity. *Economy and Society, 37*(1), 20–49.

Belcher, B. M., Rasmussen, K. E., Kemshaw, M. R., & Zornes, D. A. (2016). Defining and assessing research quality in a transdisciplinary context. *Research Evaluation, 25*, 1–17.

Berger, G. G. (1972). Opinions and facts. In L. Apostel, G. Berger, A. Briggs, & G. Michaud (Eds.), *Interdisciplinarity: Problems of teaching and research in universities* (pp. 21–74). Paris: Organization for Economic Cooperation and Development.

Birnbaum, P. H. (1977). Assessment of alternative management forms in interdisciplinary projects. *Management Science, 24*(3), 272–284.

Blackmore, P., & Kandiko, C. B. (2011). Interdisciplinarity within an academic career. *Research in Post-Compulsory Education, 16*(1), 123–134.

Boix Mansilla, V. (2005). Assessing student work at disciplinary crossroads. *Change: The Magazine of Higher Learning, 37*(1), 14–21.

Bridle, H., Vrieling, A., Cardillo, M., Araya, Y., & Hinojosa, L. (2013). Preparing for an interdisciplinary future: A perspective from early-career researchers. *Futures, 53*, 22–32.

Creamer, E. G. (2005). Insight from multiple disciplinary angles: A case study of an interdisciplinary research team. *New Directions in Teaching and Learning, 102*, 37–44.

Darbellay, F. (2015). Rethinking inter- and transdisciplinarity: Undisciplined knowledge and the emergence of a new thought style. *Futures, 65*, 163–174.

Felt, U., Igelsböck, J., Schikowitz, A., & Völker, T. (2013). Growing into what? The (un-)disciplined socialisation of early stage researchers in transdisciplinary research. *Higher Education, 64*, 511–524.

Frodeman, R. (2010). Introduction. In R. Frodeman, J. T. Klein, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. xxix–xxxix). Oxford: Oxford University Press.

Gardner, S. K., Jansujwicz, J. S., Hutchins, K., Cline, B. & Levesque, V. (2014). Socialization to interdisciplinarity: faculty and student perspectives. *Higher Education*, *67*, 255–271.

Haythornthwaite, C., Lunsford, K. J., Bowker, G. C., & Bruce, B. (2006). Challenges for research and practice in distributed, interdisciplinary, collaboration. In C. Hine (Ed.), *New infrastructures for science knowledge production* (pp. 143–166). Hershey: Idea Group.

Holley, K. A. (2009). Interdisciplinary strategies as transformative change in higher education. *Innovative Higher Education, 34*, 331–344.

Huutoniemi, K., Klein, J. T., Bruun, H. & Hukkinen, J. (2010). Analyzing interdisciplinarity: Typology and indicators. *Research Policy*, *39*(1), 79–88.

Jacobs, J. A., & Frickel, S. (2009). Interdisciplinarity: A critical assessment. *Annual Review of Sociology, 35*, 43–65.

Kessel, F., & Rosenfield, P. L. (2008). Preface to the new edition. In F. Kessel, P. L. Rosenfield, & N. B. Anderson (Eds.), *Interdisciplinary research: Case studies from health and social science* (pp. ix–xx). Oxford: Oxford University Press.

Klein, J. T. (1990). *Interdisciplinarity: History, theory and practice*. Detroit: Wayne State University Press.

Klein, J. T. (2005). *Humanities, culture, and interdisciplinarity: The changing American academy*. Albany: State University of New York Press.

Klein, J. T. (2010). A taxonomy of interdisciplinarity. In R. Frodeman, J. T. Klein, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 15–30). Oxford: Oxford University Press.

Krohn, W. (2010). Interdisciplinary cases and disciplinary knowledge. In R. Frodeman, J. T. Klein, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 31–49). Oxford: Oxford University Press.

Lattuca, L. R. (2001). *Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty*. Nashville: Vanderbilt University Press.

Lattuca, L. R. (2002). Learning interdisciplinarity: Sociocultural perspectives on academic work. *The Journal of Higher Education, 73*(6), 711–739.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Lyall, C., & Meagher, L. R. (2012). A masterclass in interdisciplinarity: Research into practice in training the next generation of interdisciplinary researchers. *Futures, 44*, 608–617.

Lyall, C., Bruce, A., Tait, J., & Meagher, L. (2011). *Interdisciplinary research journeys: Practical strategies for capturing creativity*. London: Bloomsbury Academic.

Mackey, J. L. (2002). Rules are not the way to do interdisciplinarity: A response to Szostak. *Issues in Integrative Studies, 20*, 123–129.

MacMynowski, D. P. (2007). Pausing at the brink of interdisciplinarity: Power and knowledge at the meeting of social and biophysical science. *Ecology and Society, 12*(1): Article 20. http://www.ecologyandsociety.org/vol12/iss1/art20/. Accessed 15 Feb 2014.

McCallin, A. (2001). Interdisciplinary practice – A matter of teamwork: An integrated literature review. *Journal of Clinical Nursing, 10*, 419–428.

Moran, J. (2010). *Interdisciplinarity* (2nd ed.). London: Routledge.

National Academies. (2005). *Facilitating interdisciplinary research*. National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. Washington, DC: The National Academies Press.

Nowotny, H. (2003). Science in search of its audience. *Nova Acta Leopoldina, NF, 87*(325), 211–215.

Organization for Economic Cooperation and Development (OECD). (1972). *Interdisciplinarity: Problems of teaching and research in universities*. Organization for Economic Cooperation and Development.

Palmer, C. L. (1999). Structures and strategies of interdisciplinary science. *Journal of American Society for Information Science, 50*(3), 242–253.

Petrie, H. G. (1976). Do you see what I see? The epistemology of interdisciplinary inquiry. *Journal of Aesthetic Education, 10*(1), 29–43.

Qin, J., Lancaster, F. W., & Allen, B. (1997). Types and levels of interaction in interdisciplinary research in the sciences. *Journal of the American Society for Information Science, 48*(10), 893–916.

Reich, S. M., & Reich, J. A. (2006). A cultural competence in interdisciplinary collaborations: A method for respecting diversity in research partnerships. *American Journal of Community Psychology, 38*, 51–62.

Repko, A. F. (2007). Integrating interdisciplinarity: How the theories of common ground and cognitive interdisciplinarity are informing the debate on interdisciplinary integration. *Issues in Integrative Studies, 25*, 1–31.

Repko, A. F. (2008). *Interdisciplinary research: Process and theory*. Los Angeles: Sage.

Richards, D. G. (1996). The meaning and relevance of 'synthesis' in interdisciplinary studies. *The Journal of Education, 45*(2), 114–128.

Rowe, J. W. (2008). Introduction: Approaching interdisciplinary research. In F. Kessel, P. L. Rosenfield, & N. B. Anderson (Eds.), *Interdisciplinary research: Case studies from health and social science* (pp. 3–9). Oxford: Oxford University Press.

Salter, L., & Hearn, A. (1996). *Outside the lines: Issues in interdisciplinary research*. Montreal: McGill-Queen's University Press.

Stokols, D., Hall, K. L., Moser, R. P., Feng, A., Misra, S., & Taylor, B. K. (2010). Cross-disciplinary team science initiatives: Research, training and translation. In R. Frodeman, J. T. Klein & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 471–493). Oxford: Oxford University Press.

Strober, M. H. (2006). Habits of the mind: Challenges for multidisciplinary engagement. *Social Epistemology: A Journal of Knowledge, Culture and Policy, 20*(3–4), 315–331.

Strober, M. H. (2011). *Interdisciplinary conversations: Challenging habits of thought*. Stanford: Stanford University Press.

Szostak, R. (2002). How to do interdisciplinarity. *Issues in Integrative Studies, 20*, 103–122.

Turner, V. K., Benessaiah, K., Warren, S., & Iwaniec, D. (2015). Essential tensions in interdisciplinary scholarship: Navigating challenges in affect, epistemologies, and structure in environment–society research centers. *Higher Education, 70*(4), 649–665.

van Leeuven, T. (2005). Three models of interdisciplinarity. In R. Wodak & P. Chilton (Eds.), *A new agenda in (critical) discourse analysis* (pp. 3–18). Amsterdam: John Benjamins.

Weingart, P., & Stehr, N. (2000). Introduction. In P. Weingart & N. Stehr (Eds.), *Practising interdisciplinarity* (pp. xi–xvi). Toronto: University of Toronto Press.

Whitley, R. (1984). *The intellectual and social organization of the sciences*. Oxford: Clarendon Press.

Wiesemes, R., & Karanika-Murray, M. (2009). The cross-disciplinary research group: Overcoming isolation, promoting communication and interdisciplinarity. In M. Karanika-Murray & R. Wiesemes (Eds.), *Exploring avenues to interdisciplinary research: From cross- to multi- to interdisciplinarity* (pp. 1–8). Nottingham: Nottingham University Press.

4

Interdisciplinary Interaction

Introduction

In the previous chapter we suggested that definitions of interdisciplinarity could be divided into those adopting an interactionist approach and those working from an integrationist perspective, and we begin this one by emphasising that these should not be seen as exclusive. The search for an adequate definition is more than an academic exercise reducible to issues of nomenclature; it represents an attempt to identify the essential characteristics of what is to be defined and hence involves critical engagement with the issues bearing on its nature. Where definitional differences emerge, they arise either because of differences in emphasis or because of fundamental disagreement on the essential nature of the definiendum. In the case of interdisciplinarity, the distinction we have proposed arises from a difference in the way that integration is viewed. Both perspectives recognise the importance of interaction and the necessity for some degree of integration, but while interactionists are prepared to describe any form of interaction between disciplines as interdisciplinary (in at least some sense), integrationists reserve the term for those arrangements involving a more substantial integrative element. The difference is in practice a minor one

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because on the one hand it is very difficult to specify what constitutes an adequate level of integration and on the other interaction alone—especially if brief and not accompanied by a commitment to some form of integration—would be interdisciplinary only in the very loosest sense of that term.

The aim of this chapter is to make the case for seeking to understand better the nature of interaction in interdisciplinary engagement, not to argue for the adoption of an interactionist perspective as such, and in order to establish this clearly at the outset we propose a slight amendment to arguably the broadest interactionist definition with general currency:

> Within the broadest possible sense of the term, I take interdisciplinarity to mean any form of dialogue or interaction between two or more disciplines: the level, type, purpose and effect of this interaction remain to be examined. (Moran 2010: 14)

The change we propose is a small one, but it avoids any reference to interaction and is arguably broader in scope. It involves merely the substitution of 'engagement' for 'dialogue or interaction':

> Within the broadest possible sense of the term, we take interdisciplinarity to mean any form of engagement between two or more disciplines: the level, type, purpose and effect of this engagement remain to be examined.

Although this does not avoid the charge of stretching the term 'interdisciplinary' beyond its normal limits, it embraces all possible forms and, more importantly, invites closer consideration of their nature. There is also an important technical reason for the change arising from the fact that the original is based on the assumption that interdisciplinarity is a group enterprise. In fact, it is possible—and is becoming increasingly common—for an individual to pursue an interdisciplinary career. In such cases there may be no internal dialogue or interaction in any meaningful sense, but engagement of the disciplines involved will nevertheless be essential. The term also embraces a wide range of activities, both formal and informal, including those where juxtaposition (of academic papers, talks, posters, etc. or any combination of these) might represent a form of engagement.

While recognising the broader context that is represented by the term ‘engagement’, our concern in this book is with interdisciplinary groups because this is the form most characteristic of interdisciplinary work and, just as importantly, the form in which the challenges arising from interaction are most pressing. Reinalter (1996: 156) is speaking for many when he locates the ‘main cause of emerging problems…[in]…the problem of language’, though this encompasses a great deal. It is perhaps closer to the mark to represent the problem, as does Van Leeuven (2005: 9), in terms of the difficulties experienced by researchers from different disciplines in the process of learning how to interact effectively.

In this chapter we consider briefly why interaction is so important in interdisciplinary research before moving on to make a number of important distinctions that lay the foundations for the research to follow. We shall be concerned here to explain why Van Leeuven’s (2005: 9) ‘learning to talk to each other’ involves much more than merely learning a different vocabulary or even simply learning new ways of speaking, arguing that understanding the dynamics of interaction is not reducible to general characterisations or specific rules for speaking but that it needs to be understood in its own terms as constituting the complex and infinitely rich business of getting interdisciplinarity done.

Why Interaction Matters

Interaction Is a Feature of All Research

While our focus in this book is on the interdisciplinary team, where interaction has particular salience, it would be wrong to assume that of itself this sets it apart from other forms of research. In fact, the image of the isolated academic worrying away at abstruse problems high up in his (the gender is as much a part of the stereotype as long silver hair) ivory tower could not be further from the truth: woven into the fabric the academic experience is a network of interactions, its filaments stretching from the office next door to the far side of the world and its variegated patterning ranging from chats over coffee to conference debates.

The importance of interaction is brought home by responses to Lattuca in her study of the interdisciplinary experience. A number of her respondents identified the need for interaction as one of the reasons for being drawn to interdisciplinarity, and the experience of this biologist is far from exceptional:

> I have sort of been driven outside of my department to look for people to interact with because my colleagues are not interested in interacting. [That] is my perception. …If I came into a department where people were interested in interactions among biologists, I may never have set foot outside the department. It's hard for me to tell. But this is—of departments—one of the worst in terms of people interacting with the rest of the campus. Most of my colleagues are not known—even people who have been here for thirty years aren't known to the rest of the campus. (Lattuca 2001: 174)

This experience suggests that not all academics are interested in interacting with colleagues, at least at the local level, though of course other forms of interaction are possible, including those using different media. More pertinently, it points to the importance of interaction in interdisciplinary work by highlighting this as a feature that makes it attractive to some researchers. As Lattuca (2001: 142) found in her study, in the eyes of some informants 'collaboration defined interdisciplinarity', though this took many different forms. While some tended to work for long periods with the same colleague, others moved from colleague to colleague depending where their research questions took them, and yet others were used to working with colleagues from a range of disciplines. Therefore, while interaction may be a vital element in interdisciplinary research, the forms of collaboration in which it might feature—which will in turn influence its form—are varied.

Collaboration Depends on Interaction

By its very nature, an interdisciplinary project is collaborative, bringing together representatives of different disciplines and depending for its success on their ability to work together. The importance of this is brought out clearly in the description of interdisciplinary research proposed by Bridle et al. (2013: 23):

> …a common view is to consider interdisciplinarity as a means to address complex problems that cannot be dealt with from a single disciplinary perspective alone. Such problems require people from different disciplinary perspectives to work together, sharing ideas, theories and practice to reach appropriate solutions. For interdisciplinary research to be effective in addressing these problems, therefore, the conditions must be created in which appropriate interactions can be fostered between researchers

The nature of these appropriate interactions, and the conditions that facilitate them, will vary widely, but they are the foundation of successful collaboration. One of the main challenges, as Strober (2011: 43) has noted, is that when engaging in interdisciplinary talk participants tend to take for granted that the ways of speaking characteristic of their own discipline are in fact universal. Hence the process of adjustment to the process of doing interdisciplinary work involves accommodation to new ways of talking as well as new ways of understanding. It is here that the interactional and integrative elements of interdisciplinarity intersect, facilitating collaborative achievement. At a deeper level, intense engagement in the collaborative process may engender fundamental shifts in knowledge or disciplinary perspective.

The importance of direct interactional engagement in this process seems to be appreciated by participants, at least if the findings of Qin et al. (1997) are generally applicable. Their survey involved 50 scientists engaged in collaborative research whose work had featured in the authors' bibliometric analysis of interdisciplinary papers. Most of their respondents favoured interactive over non-interactive communication, with team members being the main interactants but with informal conversations involving colleagues in their own institution also featuring. Discussion groups or other computer networks were much less popular, with only one in six of the participants using them.

Epistemic Differences Need to Be Negotiated

Underlying the sorts of adjustment highlighted in the previous section is the need to reconcile fundamental epistemic differences. Differences in research traditions and approaches, in conceptual orientations, and in ways of thinking and of understanding the research process (including parameters of legitimacy) can represent significant barriers to understanding. This has led a number of researchers to argue along the same lines as Robertson et al. (2003: 9) that 'a commonly understood language and set of methods are key to overcoming the ontological and epistemological challenges of interdisciplinary research.' The problem is that such claims, while irrefutable, have so far not been based on an analysis of interdisciplinary interaction that would allow an understanding of what the development of such a language might involve.

The need for such understanding is evident in the outcomes of a transdisciplinary project in which barriers to understanding needed to be broken down:

> One of the key challenges we faced in our transdisciplinary project was that, before experts could exchange explicit knowledge across fields, they often needed to make tacit field-specific knowledge explicit. Experts found this task very challenging because it is difficult to identify tacit knowledge of a field when immersed in it (indeed, a fish does not know what water is). Another way to transfer tacit knowledge is to support long-term involvement across fields, which allows tacit knowledge to be shared through socialization. (della Chiesa et al. 2009: 22)

The nature of the problem is clearly articulated at the outset: the challenge is not simply one of exchanging knowledge, which in itself would be relatively straightforward, but of finding ways to make explicit the sort of tacit knowledge that is the product of long immersion in the ways of a particular discipline. The response of della Chiesa's team was to maintain long-term involvement in order to allow space for understanding to develop through the process of socialisation, which represents an excellent solution in situations where the arrangement can be sustained, but the lifespan of many projects—perhaps the vast majority—does not allow for this. The challenge lies in developing a sufficiently deep understanding of the nature of interdisciplinary interaction at least to facilitate the process. The first step in this is to appreciate the scale of the challenge involved.

Ways of Speaking

> Communication between individuals endowed with different conceptual structures is not simply a precondition for attaining interdisciplinary insights, but is an essential component. (Bromme 2000: 118)

While there seems to be no disagreement about the need to achieve productive understanding, the recommendations for achieving this that have so far been proposed, although illuminating and helpful in general terms, have not sufficiently appreciated the complexity of what it involves. In this section we begin by identifying the nature of that complexity before going on to consider two responses to the challenge, pointing out their limitations. The section concludes with an outline of what is needed in order to develop more sophisticated, if less categorical, understanding of the nature of interdisciplinary interaction.

Learning the Words and Learning the Language

The project reported by della Chiesa et al. (2009), who adopted a knowledge management perspective, lasted from 1999 to 2007 and was designed to investigate how neuroscience could inform education policy and practice. The importance of della Chiesa et al.'s analysis lies in the extent to which it exposes the limitations of naïve assumptions about creating a common language. At first the researchers assumed that this would solve the communication problems that would inevitably arise, but over time the limitations in their assumptions about the nature of this language were starkly exposed. In an insightful account of the process, the authors reveal that they had worked from the assumption that the problem was one of terminological discrepancy and that it could be resolved by finding common expressions that in turn would lead to common representation and shared understanding. This proved illusory and it is instructive to consider why.

It is perfectly evident that there are terminological differences between disciplines, just as different languages have different words for the same objects. However, learning to translate these terms or developing a common vocabulary on the basis of them represents only one step—albeit a significant one—on the road to understanding. As the first chapter of this book showed, embedded within disciplines are particular ways of thinking and understanding that are assimilated as part of socialisation into the discipline. The engagement of two disciplines is not unlike the meeting of two cultures, each with its own ways of understanding and representing that understanding. The direct analogy between different disciplines and different languages drawn by Bauer (1990: 112–113) succinctly captures the implications of this: '[j]ust as in languages the vocabulary cannot be entirely separated from the grammar, the syntax, or indeed the national culture, so in the disciplines "knowledge" cannot be isolated from the conjugate methods, the theories, or indeed the history and practice of the field.'

Despite this, much work on interdisciplinary research represents language challenges as merely matters of differences in vocabulary. Salter and Hearn (1996), for example, identify three problems characteristic of encounters between different disciplines: a translation problem, a language problem and a reception problem. The last concerns how interdisciplinary work is received (publication, assessment, funding, etc.), but the other two are language related. The translation problem involves the movement of information from one discipline to another and 'is made more difficult by what we call the *language problem.* The language problem arises because the same words are used in quite different ways in different disciplines' (Salter and Hearn 1996: 143–144). That the authors, in common with many others, see this problem purely in terms of vocabulary is evident in their identification of its three dimensions: different dictionary definitions, the fact that many terms are contested concepts, and terminological borrowing. While these are undoubtedly problems, resolving them alone leaves unaddressed broader interactional challenges facing interdisciplinary groups—as della Chiesa and his colleagues discovered.

That said, the importance of terminological differences should not be underestimated and has proved alluring to at least one researcher working within a broadly ethnographic tradition. In her research on the work of an interdisciplinary team of care professionals, educators and medical doctors Manor-Binyamini (2011) draws on detailed notes of meetings over a full year (247 in all), formal interviews, informal corridor conversations and a range of documents. Although she uses what she describes as ethnographic discourse analysis, her decision to draw heavily on Hurford and Heasley (1983) leads to a procedure that focuses very much on key words and phrases, linking them to relevant groups in the interdisciplinary encounter, determining the meaning of the word for these users, identifying what they are trying to achieve and calculating the frequency of the word's occurrence. This is used as the basis for identifying the transferability of these terms across groups and as such the findings represent a valuable extension of work on terminological challenges in interdisciplinary engagement. It does not provide either the ethnographer's insight into the culture of the groups involved or the discourse analyst's insight into the construction of the talk itself, but it nevertheless opens up an important line of enquiry.

The investment in understanding that is required of participants in such groups is in fact considerable and involves much more than the acquisition or transfer of relevant vocabulary, however important this might be. Hunt (1994: 6) has set out very clearly what is required from a disciplinary perspective:

> A good interdisciplinary conversation depends on a serious commitment to other disciplines as disciplines – not on giving up one's own, but on following the other at least part of the way in which it leads. Such a commitment, like learning a foreign language and experiencing a foreign culture, creates a different relationship to one's own discipline. You gain a certain distance from your own discipline and a measure of imperviousness to the conventions that define it.

In view of the demands made on participants, it is surprising and also disappointing to note that research into interdisciplinarity has neglected to investigate in detail the engagements through which such changes are realised and has instead proposed responses based on more general understanding.

Common Ground

An approach that has gained some currency is that drawing on the psychological concept of common ground. This postulates that communicative acts are based on the assumption that participants share a cognitive frame of reference representing common ground and that all contributions to the creation of mutual understanding involve either identifying or establishing this common ground, thereby serving to maintain it. Bromme (2000), who applies Clark's (1996) theory to interdisciplinarity, argues that differences in common ground are often discovered only when participants discover either that they are using the same concepts with different meanings or that they are representing the same concepts using different terms or other codes.

As a psychological account of the cognitive processes involved in interaction, this may be perfectly sound and, as the next section shows, it has much in common with the explanation of social interaction on which our own analysis draws, but it has been used as the basis for claims about the nature of interdisciplinary engagement that seem unduly restrictive. Repko, who is an ardent proponent of the integrationist perspective, draws on the work of Bromme to develop a strongly integrationist position, arguing that if creating common ground is 'natural and achievable' then the same will apply to integration as well as its product, interdisciplinary understanding (2007: 11). Integration therefore emerges as a necessary condition for the achievement of interdisciplinarity and hence must feature in any definition of it.

Repko's (2007) historical overview of the development of thinking on common ground in interdisciplinary research is interesting in terms of where it places emphasis. Identifying 1958 as the first example of a reference to integration, he draws attention to the work of Kockelmans (1979) and later to that of Klein (1990) and the importance they place on 'common vocabulary' as a condition of achieving interdisciplinarity. He extends particular consideration, however, to Newell's (2001: 15) extension of Klein's model that adds 'creating new ground'. One of the aspects that Repko (2007: 7) identifies as making this particularly significant is the distinction between creating common vocabulary at the start of a project and the more complex task of creating common ground between conflicting scholarly insights, the relationship being sequential (the latter emerging after the former) rather than simultaneous. This deserves particular attention because it points to a problem with the model that Repko then goes on to develop.

A clue to the problem lies in the four features of Bromme's theory that Repko chooses to highlight, two of which claim that common ground can be realised in the form of common terminology. As the last section argued, and as the project analysed by della Chiesa et al. illustrated, vocabulary is but one aspect—albeit it an important one—of a much wider engagement and needs to be seen in the context of this. This engagement is a complex and evolving process that is not susceptible to divisions into distinct elements. The claim that the establishment of a common vocabulary *precedes* more complex conceptual engagement makes the naïve assumption that it is possible to establish an adequate vocabulary in the absence of the conceptual apparatus necessary to make this sufficiently meaningful. The two develop together, not just in terms of the vocabulary items that are used but also how these are deployed and interpreted as common understanding deepens. The collaborative process involves not just the acquisition of a common vocabulary but the development of *ways of speaking* that are adequate to the social and intellectual tasks encountered by participants. Repko is not wrong to claim that establishing common ground is both natural and achievable—it is indeed the basis of our everyday encounters—or that it is the foundation for integrating different intellectual perspectives, but the latter are instantiated through talk. One is not based on the other because both are implicated in the same process, and if we wish to understand interdisciplinary engagement, it is the discoursal evidence of this process that we need to examine.

These criticisms of Repko's representation of the interactional processes involved do not necessarily undermine his account of the cognitive processes involved or his suggestion that there are three ways of reconciling conflicting insights, though his proposals for achieving these still place great stress on the resolution of terminological issues without due consideration to the interactional context in which they arise. He does recognise the importance of context, but his insistence that applied disciplinary work 'means taking into account all factors—internal and external—that impinge on the problem and that are rendering it more or less susceptible to finding common ground and achieving integration' (2007: 11) represents an impossible requirement. Quite apart from the impossibility of identifying all the factors that might be relevant, as Garfinkel observed, contextual explanation is endlessly iterative, susceptible only to the social limits we place on accounts.

Interdisciplinary Conversation

While Repko's aim is to advance the case for an integrationist definition of interdisciplinarity at the expense of more general interactionist alternatives, other researchers have focused more explicitly on the nature of interdisciplinary talk. One researcher who has done much to promote productive forms of such talk is Myra Strober (2011) in her focus on the *interdisciplinary conversation*. The value of her work lies particularly in its recognition that interdisciplinary interaction is as demanding as talking to representatives of other cultures. She illustrates this very persuasively with accounts by those who have experienced the challenges it brings, recounting, for example, the case of a mathematician who gave a talk that other participants could not understand and did not himself contribute to any of the other seminars. Another participant commented that there seemed to be 'two different languages…but…no means of communicating', while the mathematician admitted that he 'hadn't gotten used to that kind of interaction. It is quite different from the way mathematicians interact' (Strober 2011: 42).

Faced with problems of this sort, Strober set out to find ways in which such encounters might be improved, which led her to identify two very different approaches. What she calls the 'doubting game' is adversarial and aims to identify error, while its alternative, the 'believing game' is cooperative in orientation and seeks to discover truth. The latter offers the possibility of encountering unexpected truths but at the risk of coming to believe something that is not true, while the doubting game reduces the possibility of this at the expense of missing something true (and potentially important) that does not coincide with one's initial prejudices (Strober 2011: 164).

On the basis of this, Strober offers advice on how interdisciplinary conversations might be more productively approached, recommending, for example, that participants should listen to one another with empathy. She provides evidence from an analysis of six interdisciplinary seminars held at three universities that demonstrate the value of her approach and underline the importance of effective leadership, which she describes as 'the single most important ingredient for creating successful interdisciplinary conversations' (2011: 117). Interestingly, her comments on the value of productive conflict align well with Repko's position, though the anticipated outcomes of the seminars (the creation of interdisciplinary courses and research ideas) did not materialise and none of the institutions involved built on the foundations laid in the seminars.

Strober's work is interesting because of its focus on interaction and the attention it draws to the importance of leadership in fostering effective engagement. However, like so much other work in this area, her analysis draws on interviews and is not based on an analysis of how the talk itself was constructed, so that what we have is essentially impressionistic. However revealing this might be—and it generates interesting insights—this does not allow access to the interactional processes that contribute to the achievement of productive engagement. In standing back from the talk itself it also fails to reflect or engage with the complexities of interaction or of epistemological engagement (see Kellert 2008 for a discussion of the latter from the perspective of chaos theory).

The efforts that have been invested in understanding interdisciplinary engagement have borne fruit in terms of our understanding of the experiences and perspectives of those involved, but the relatively limited attempts to address interactional issues have either adopted approaches that are too limited, placing excessive emphasis on terminology at the expense of discourse, or have offered general advice that is not based on the analysis of the interaction itself. 'Interdisciplinary communication', as Kalra and O'Keeffe (2011: 170) starkly observe, 'is rife with challenges.' In the following section we describe approaches that have been taken to understanding these challenges, using this as a prelude to the approach adopted in this book.

Investigating Interdisciplinarity

In this section we offer a brief sketch of different approaches to researching interdisciplinarity, highlighting what they have contributed to our understanding of the topic but where necessary also indicating their drawbacks. In doing so we are not setting out to make a case for the methodological advantages of the approach adopted in this book but are seeking rather to show how it can complement research already available, why it is necessary and what it can add to our understanding of interdisciplinarity.

Case- and Interview-Based Studies

Although research into interdisciplinary practice is impressive in its range, the advantages of this are mitigated at least to some extent by the overwhelming dominance of case study research and interview-based studies. Interestingly, those who criticise excessive reliance on case studies often respond with interview-based studies (e.g. Mansilla 2008), thus contributing to the distortion of perspective. While such approaches are valuable in many respects, their limitations also need to be recognised.

Much case-based research in this area comprises personal accounts rather than case studies as such, often focusing on the development of a project in which the writer was involved. While such accounts may be soundly theorised, often drawing on sociocultural concepts such as communities of practice, the methodological concerns evident in the account are often not reflected in the design of the case itself. All explore aspects of interdisciplinary engagement, though some are interested primarily in methodological negotiations (e.g. Hemmings et al. 2013) or issues raised with respect to particular disciplines (e.g. Lau and Pasquani 2008).

Genuine case study research in the area draws on broader data sets, but even here methodological details are often provided only in bare outline with no information on how the analysis itself was conducted. Amey and Brown, for example, draw on a rich data set comprising 'observations of team meetings, audio-recorded individual interviews with team members, analysis of project documents… and analysis of reflective papers written by team members' (2005: 24), but provide no methodological detail. Restrictions of space also mean that researchers may have to represent these extensive sets using interview extracts from just one or two participants (e.g. Creamer 2005).

The disadvantages of personal accounts and selective representation are clear enough and need little elaboration. In the case of the former, the individual perspective may not be shared by other participants and, as ethnographers are at pains to emphasise, the insider inevitably takes for granted much that is important and clear to a researcher unfamiliar with the relevant context (but see Strathern 2011 for explicit recognition of insider status). In the absence of sound methodological warrant, selective representation is also open to a charge of imbalance. In spite of these disadvantages, however, the value of richly described and soundly theorised cases should not be underestimated, and interdisciplinary researchers can now draw on a valuable fund of different perspectives on interdisciplinary research covering a range of disciplines.

Interview-based studies constitute an even more extensive source of insider accounts, this time gathered from third parties. Taken together, they provide an opportunity to identify a number of important issues in interdisciplinary research, though none of them recognises the challenges inherent in interview-based research. Potter and Hepburn (2005) identify five of these (see also Mann 2011), including two that are particularly telling: the deletion of the interviewer and the failure to consider interviews as interaction. Interviews are co-constructed interactional events in which the contributions of the interviewee are not decontextualised reports but situated accounts representing their constructions of events, understandings, reflections, and so on made as part of a series of exchanges with the interviewer. How the interviewer asks a question, how he or she reacts to the subsequent response, how this is interpreted by the interviewee, who may see themselves and the interviewer as representing particular categories of person, all bear on the interpretive positioning of participants.

While this does not impose on the researcher a requirement to subject all extracts to the sort of close analysis that is applied by those who study interaction, it does call for a degree of sensitivity and a willingness both to include interviewer turns where possible and to represent interviewee contributions as accounts. None of this is evident in the interview-based studies that make up such a substantial proportion of research on interdisciplinarity. While not undermining the many valuable insights that such research collectively has generated, this does serve to intensify the need for direct evidence of what happens in interdisciplinary research encounters.

Psychological Approaches

Interview- and case-based approaches drawing out individual perspectives have opened a window onto the interdisciplinary experience and identified some important general issues, but from a psychological perspective the inadvisability of seeking to identify personal traits and using this as a basis for analysis in such contexts has been highlighted by Bromme (2000).

This may go some way towards explaining why attention has been directed to the nature of interdisciplinary teamwork, where careful analysis of participation has yielded valuable insights into characteristics that are associated with success.

The list of key areas identified by Lakhani et al. (2012) in their review of interdisciplinary literature from medicine, nursing and psychology databases can be taken as fairly representative of core topics related to interdisciplinary teamwork in general (team purpose, goals, leadership, communication, cohesion, mutual respect and reflection), and there seems to be general agreement on the importance of effective team leadership, explicit role definition and strong team relationships. Such work needs to be set in the broader context of work on teams and is consistent with findings on teamwork generally, where success is characterised by a number of factors: 'identification with the team, a shared perception of interdependence, low power differentiation, social closeness, collaborative conflict management tactics, and a win-win negotiation process' (Donnellon 1996: 207).

The findings presented in the following chapters should be seen as complementary to this work. Our focus on the nature of the talk through which interdisciplinarity is realised provides no insights into psychological states or dispositions, but it does lay bare the interactional practices of group members and in so doing works from a distinctly different perspective that may provide support for, or call into question, claims made on the basis of psychological approaches.

This can be illustrated by reference to a study adopting a psychologically theorised case approach. Drawing on their own experiences, Curry et al. (2012) used representational group theory to explore the dynamics of a mixed methods research team in health sciences. They propose a number of principles for dealing with the main challenges in such contexts, all of them consistent with other findings on the topic: dealing with differences, establishing trust, creating a meaningful group, handling conflict and tension and enacting effective leadership. One of the conditions for creating a meaningful group is the development of a common language, which they argue is facilitated by what they call 'methodological bilingualism'. They recommend the development of a team glossary as well as the inclusion of individuals with transdisciplinary training.

They also argue that their approach is consistent with generally agreed strategies for interdisciplinary teamwork that include 'epistemological plurality' in which no single paradigm emerges as dominant.

While these recommendations may be sound enough in themselves, the absence of interactional guidance on how they might be instantiated means that their adoption may be no more than minimal, especially in the face of challenges not anticipated by the authors. The limitations of assuming that resolving differences in vocabulary is adequate for overcoming 'linguistic' differences have already been highlighted, the recommendation of 'methodological bilingualism' might be susceptible to what Misra et al. (2011) have called 'information and communication overload', and Chap. 7 will show how assumptions of disciplinary parity might be undermined by interactional practices.

Systems Approaches

The approach adopted in the chapters that follow views interdisciplinary engagement and the knowledge construction associated with it as inherently social process, but there is an alternative position adopted by information scientists that draws on the analysis of documentary outputs, typically academic papers. Since the two are distinct in approach (but see Beers and Bots 2007 for work that draws on both perspectives) and the findings from systems approaches will not inform our own work, we mention it for the sake of completeness and in order to highlight its contribution to an understanding of interdisciplinary engagement in different disciplines.

Qin et al. (1997), for example, undertook a bibliometric study, supported by a survey of researchers, of different types and levels of interdisciplinary collaboration in the sciences. The results revealed considerable differences amongst the sciences in terms of collaborative orientation, but with a trend towards interdisciplinarity that was especially marked in biology and the medical sciences. A bibliographic study by Garvin (2012) produced the same findings in the social sciences, arts and humanities, in this case with sociology, psychology and social work standing out as the most interdisciplinary in approach.

Analysing Talk

> The one variable that recurred constantly in this research was communication. Participants were always talking, talking, talking…Over and over again team members were observed conversing together, propping up walls, liaising in lifts, chatting in corridors, musing at meal breaks, and discussing disciplinary differences at team meetings or in spontaneous conversations taking place as they worked together. Dialoguing, the basic social process, pervaded practice and was confirmed as the essence of successful interdisciplinary teamworking. (McCallin 2004: Paragraph 10)

The pervasiveness of talk in interdisciplinary research that strikes McCallin so forcefully makes it a prime candidate for investigation. Yet, as with McCallin's own study, work in this area draws overwhelmingly on interviews and sometimes fieldwork rather than looking closely at the talk itself, even though, as Roberts and Sarangi (2005: 632) succinctly note, 'In institutional encounters, talk *is* work.'

In fact, although interdisciplinary communication has been extensively theorised (for an interesting discussion of different positions, see Holbook 2013), and at least one model of communication in interdisciplinary teaching has been proposed (Woods 2007), empirical evidence of its nature is alarmingly skimpy, with most researchers basing claims about it on observation, intuition, or verbal reports from practitioners. This neglect of spoken interaction in academic contexts is not limited to the interdisciplinary sphere. As Biber et al. (2002: 12) note, while research on academic writing in its various forms has produced a rich and diverse body of work, '[f]ew studies have described the linguistic characteristics of spoken academic discourse.' With a handful of notable exceptions (e.g. Lynch 1985; Ochs et al. 1994; Ochs and Jacoby 1997) this has tended to take lectures as its subject, often focusing on discourse markers, lexical chunks or their overall structure.

There has been limited research on the interaction involved in interdisciplinary work, some based on fine-grained analysis and some more general. An example of the former is Housley (2000), who uses conversation analysis and membership categorisation analysis to analyse knowledge construction and display in multidisciplinary flood team meetings. A less microanalytical approach, but one with a valuable practical dimension, is adopted by Akkerman et al. (2006), who draw on the work of Bakhtin in their analysis of multivoicedness in an international collaborative research project involving the educational sciences. Their work is notable for including in its data set not only relevant documents and interviews with participants but also video recordings of meetings, the selective use of these preceded and informed by the analysis of interviews. The findings allowed the authors to challenge the prevalent view that collaboration depends on overcoming diversity, arguing instead that otherness should be valued, that particularities and boundaries should be made explicit and the arguments of others be treated as strange and new, thereby facilitating greater understanding of other viewpoints. Interestingly, one of the three lessons drawn by Lingard et al. (2007), who rely entirely on narratives in their analysis of the politics of identity in a research team, is that tensions in member identity need to be explicitly negotiated and that working through these tensions can generate analytic insights, a finding that supports the position adopted by Akkerman et al. This provides an illustration of how a focus on interaction might be naturally integrated into our developing understanding of the work of interdisciplinary teams.

In what follows we situate our approach within the context of discourse studies generally, explaining what is distinctive about it and specifying what it sets out to do. The section begins with a very brief overview of options in discourse analysis and a general statement of the fundamental assumptions underlying the analysis in this book. It then describes the approach adopted, providing details of the data set and methodological choices made as part of the analytical process.

Discourse Analysis

We have chosen the term 'discourse analysis' to describe the approach adopted here, but the term is so wide-ranging as to be useful only as a very general descriptor. A more precise specification is called for and in order to set this within the broader context and justify the use of the label it is necessary to identify the essential characteristics of discourse analysis.

Fortunately, Antaki (2008) provides just this in what may be the most succinct summary available, his four essential features applicable to any approach describable as discourse analysis. The talk or text, he observes, should be naturally occurring and not invented by the analyst, and the words used must be interpreted with at the very least due consideration to their co-text, extended to their broader context if this can be justified. The analyst must also be sensitive to the non-literal meaning of the words or their force, and the analysis must serve to reveal the social actions and the consequences of the use of those words.

Under this general umbrella are gathered a host of different approaches to discourse. Stubbe et al. (2003), for example, list conversation analysis, interactional sociolinguistics, politeness theory, critical discourse analysis and discursive psychology in their collection of papers on workplace discourse, while Aijmer and Stenström (2006) identify spoken corpora, conversation analysis, discourse analysis (Birmingham School) and interactional sociolinguistics, with only conversation analysis common to both lists. A core issue within these is the relationship between context and interpretation, with conversation analysis relying entirely on evidence within the talk itself and insisting that invoking context as an explanatory resource undermines the robustness of claims that can be made since the features used will necessarily be selected from a range of possibilities (but see van Dijk 2006 for a very different view of context). Implicit in this is the charge of introducing the analyst's own categories by the back door, though critical discourse analysts (who draw on a range of theoretical and analytical resources from Foucaultian discourse theory to Hallidayan functional grammar) would argue that a refusal to take account of the broader societal or institutional context and associated power structures within which participants are acting produces a distorted picture. A third position, applied conversation analysis (for a brief description, see Richards 2005), adopts a less purist position than its parent approach, and it is here that discursive psychology is sometimes positioned (see, for example, Hepburn and Wiggins 2007).

One positive outcome of these divisions within the field of discourse analysis is an increasing willingness to draw on the range of analytical resources available. This has been realised formally in the development of linguistic ethnography, an approach that brings together both interactional data and those derived from interviews, documents and observation (for an excellent introduction to this, see Copland and Creese 2015), but it has also manifested itself less formally in an increasing eclecticism. The representatives of the approaches listed by Stubbe et al. adopted 'an eclectic approach to their analyses, applying elements of one or more models as relevant to their research objectives' (2003: 52), and this is reflected in our own analytical position, which draws on the theme-oriented approach developed by Roberts and Sarangi, in part because it 'encourages a free-range D[iscourse] A[nalysis], drawing inspiration from many approaches' (2005: 639).

Underlying our approach is the fundamental assumption that communication is not merely a medium for decision making but constitutive of it (Poole and Hirokawa 1996), which makes a focus on the situated production of talk particularly important. An orientation to the process of production also foregrounds the reflexive relationship between talk and the context in which it is produced, for although the talk may be in part defined by a particular context it also serves to define that context. For example, every time a researcher in an interdisciplinary group memberships themselves through the construction of their talk as representing a particular discipline, they are not only responding to a state of affairs recognised by other members of the group but also confirming and reinforcing that state of affairs through their action; and as a result, unless they mark it as exceptional in some way, their subsequent talk will be interpreted by other members as a production of a representative of that discipline (with all the assumptions and possibly prejudices that might be associated with this). As groups spend more time together, these exchanges create an interactional history that both reflects and influences the instantiation of the group's practices. As Frey (1996: 19) puts it, they create a 'deep structure' against which interactional work of the group must be understood:

> Most real-life groups are embedded within a history that constitutes and continually is reconstructed by their communication practices and decision-making outcomes. This shared history, constructed socially over time through language, arguments, stories, and symbols, represents a 'deep structure' that influences the 'surface structure' of a group's interactional patterns and decision making.

The following section explains how the research on which this book is based seeks to capture these two levels.

Methods

If it is to contribute to our current understanding of interdisciplinary research, discourse analysis needs to be directed at the topics that have emerged most prominently and needs to capture at least some sense of the range of disciplines and forms of engagement involved. The data collection and analysis that follows derives from this consideration and from our primary aim, which is to throw light on the nature of interdisciplinary spoken interaction in order to suggest in what ways an understanding of it might contribute to more effective interdisciplinary engagement.

Selectivity is a necessary feature of all research, and discourse analysts in particular are aware that it is impossible to specify—much less take account of—all the factors that might be relevant to any particular exchange or position taken up by a participant: there might always be hidden factors influencing particular acts. This is not to deny the relevance of a broader context or the value of drawing on it where this might have explanatory value, but subsequent claims must be recognised as being highly inferential. Contextual factors can be identified through interviews, but as already explained these need to be handled with care and a substantial data set is required if different perspectives are to be taken properly into account. Although we interviewed some of the participants in this study in order to gain some contextual understanding, we have not drawn on data we collected from these interviews. This decision is not based on a rejection of the potential value of participant views or reported histories but is consistent with the aim of the project and reflects a concern with evidentiary access: basing our claims on participant talk alone allows us to present evidence of that talk in the form of written transcripts. As explained below, this still has limitations that need to be borne in mind, but it at least provides relatively direct access to the evidential basis for claims made.

Theme-Focused Analysis

The options open to a researcher approaching such broad interactional territory boil down to (1) subjecting a small but precisely delineated fragment to intense analysis in order draw out characteristics that might be more generally relevant, (2) applying a lighter touch to the field as a whole with a view to identifying prominent or potentially interesting features, or (3) seeking a compromise that draws on both options. While recognising that all compromise involves some loss, we have opted for the third position, drawing on the substantial body of research on interdisciplinary work that already exists in order to provide a frame for the analysis.

The analysis itself draws on the work of Roberts and Sarangi (2005), who propose a theme-based approach. Sarangi (2005) points to the valuable distinction drawn by Schiffrin (1987: 19) between what she calls sequential accountability, which 'provides a comprehensive understanding of the coherence in a text' and distributional accountability, providing an explanation of why a particular element is to be found in one discourse environment rather than another. However, he argues that in addition to this, attention should be paid to thematic staging and critical moments, characteristic of the approach he developed with Roberts:

> Theme-oriented discourse analysis looks at how language constructs professional practice. Recordings of naturally occurring interactions are transcribed and combined with ethnographic knowledge. Analytic themes drawn primarily from sociology and linguistics shed light on how meaning is negotiated in interaction. (Roberts and Sarangi 2005: 632)

There are four phases in this approach, only three of which we use in our own work. The first involves ethnographic research to identify the 'communicative ecology' of a particular setting, such as local circumstances, the identities of participants, what they talk about and how they talk about it. Although we have gathered basic information on this through observation and interviews, our approach falls far short of what is properly ethnographic. However, we compensate for this by extending the second phase from the audio or video recordings of only key interactions recommended by Roberts and Sarangi to a large database of recordings.

Analytically, our approach corresponds to the four stages of the analysis phase recommended by Roberts and Sarangi: repeated listening to or viewing of recordings to identify phases in the interaction; transcription of the interaction at different levels of fineness as appropriate; a return to the whole interaction to examine the outcomes and where possible obtain feedback from the participants; and finally repeated reading informed by linguistic, sociological and cultural concepts. The fourth phase, representation, takes the form of case studies of whole interactions or the comparative analysis of distinct phases. As the next section explains, our representation focuses more on features than phases, though the general principle of comprehensive representation applies.

The approach adopted here follows Sarangi (2005) in using what he labels *activity analysis*, a combination of close analysis and visual representation of quantitative data (distribution and type of turns). However, an important difference between our approach and that of Roberts and Sarangi is that although we draw on linguistic and sociological themes in our analysis, our broad analytic themes are not derived directly from these but have been determined by examination of the data set in the light of the extensive work already available on interdisciplinary research. This has produced three key themes that form the core analytical chapters of the book:

Knowledge	The exchange of knowledge is arguably the most fundamental feature of interdisciplinary engagement and it is therefore important to extend our understanding of it. Housley (2000: 104) makes an important point about the value of drawing on evidence from the interaction through which interdisciplinary work gets done, noting that 'multidisciplinarity as a framework through which distinct bodies of knowledge feed into decision making through a team framework, needs to be considered alongside the in situ interactional characteristics of the exchange of Information and the recognition of knowledgeable utterances within team-based contexts.'
Identity	Fundamental to nearly all interdisciplinary research is the existence of groups, and the membership of these groups, constructed and represented through talk, is inextricably bound

up with professional identity. The importance of disciplinary identity in this context emerges prominently from previous studies, as the last two chapters have made clear.

Leadership A common feature—perhaps the only common feature—of research that has been done into the effectiveness of interdisciplinary groups is the importance of effective leadership. This makes the interactional achievement of this an important topic of investigation.

Mapping and Mining

A small-scale survey of corpus-based linguists conducted by Lee in 2005 revealed that there was general agreement that very little discourse analytic work had been done in this area at that time, though he noted that 'it is eminently possible for a corpus-based linguist to do genre analysis or conversation analysis' (2008: 87). In fact, there seem to be two fundamentally different approaches to the use of corpora in the analysis of spoken discourse, the first aimed at identifying specific text varieties for the purposes of categorisation and comparison and the second, more iterative in nature, designed to understand specific features of the interaction and how these might be patterned across different texts.

The first approach is exemplified most clearly by Biber, whose work on dimensions of variation (e.g. 2008) has led to comprehensive descriptions that can be used to inform, for example, the teaching of English for academic purposes (Biber et al. 2002), while the work of Walsh et al. (2011) has taken up the challenge of the second. Bringing together conversation analysis and corpus linguistics, they adopt an iterative process of analysis that begins with an initial 'scoping', using the latter to point up patterns which are then investigated using conversation analysis. This in turn informs more directed investigation of the corpus. This is the approach adopted in the chapters that follow, though the close analysis of interaction used here is merely informed by conversation analysis rather than being mainstream.

What is at stake in an approach seeking to combine these two traditions is the fundamental incommensurability of analyst-imposed categories and participant-designed features of talk. The attraction of approaches that allow the assignation of a priori categories based on features identifiable in the interaction is that they facilitate the sort of coding that makes extensive data sets accessible to the analyst. However, in achieving this they leave unexamined what Schegloff (1991: 46) has called the 'structure and texture of interaction which the talk is itself progressively embodying and realizing'. This fine-grained analysis of particular sequences is not susceptible to quantitative analysis because, as Heritage (1995: 406) points out, it leads to an 'external' view of the data, 'draining away the conduct-evidenced local intelligibility of particular situated actions which is the ultimate source of security that the object under investigation is not a theoretical or statistical artefact'.

For these reasons it is important to keep the two approaches distinct analytically (see Choi and Richards (2012) for a more extended discussion of their relationship) while exploiting the potential of their complementarity. For although the results of computational analysis can be treated as no more than indicative, they provide a picture that is not practicably accessible to the conversation analyst. The delicacy of analysis required in this latter approach allows for particular phenomena to be studied across very large data sets (analysis may in some cases unfold over a number of years) and the approach has been very successful in identifying distinguishing characteristics of particular forms of institutional talk (Drew and Heritage 1992), but application across large data sets in toto is much more problematic. This means that it is not well placed to respond to the challenge implicit in Clarke's (2005: 191) description of what is needed to bring the analysis of professional talk in line with practitioners' expectations:

> Studies of talk-in-interaction, whether labelled as CA or DA, would align more readily with the perspective of professionals if they could examine episodes of interaction as long as the whole consultation…Professionals will perhaps be more enthusiastic about collaboration if the lens used to study their activities could be switched to even a slightly lower power, so that the give and take of discussion over a longer period – perhaps even during the whole of a consultation – could be examined.

This is where the sort of iterative process proposed by Walsh et al. offers the analyst an opportunity to gain insights into patterns across data sets that can be treated as provisional until set alongside more detailed analysis of the features identified. Unfortunately, current computational techniques for analysing large data sets, while invaluable for measuring features such as frequencies of certain keywords or expressions in the text and proportions of participants speaking time in the talk, and visualising these findings, are not designed to facilitate the analysis of the interactional dynamics of talk.

In response to this, Choi (2016) developed the Interactional Discourse Lab (IDLab), a free visualisation tool that captures the interactional dynamics of talk-in-action using both qualitative and quantitative methods. It automatically generates interactive visualisations of the patterns of interactions from an input transcript that has been tagged by an analyst. The IDLab processes the tags to visualise the information using R, a statistical programming language (http://r-project.org). The generated visuals are then displayed in three separate panels (speakers and tags, interactions and timeline), each panel updating the relevant statistics and graphs according to the tags selected by the analyst. This visual representation offers a synaptic view of the dynamics of spoken engagement, highlighting frequent exchanges and important contributors. The frequencies themselves can be read in the associated table, and each frequency comes with a confidence interval to convey the uncertainty attached to the measurement.

The IDLab offers an opportunity to map patterns of talk within specific domains and is particularly valuable where the focus is on groups that have worked together over time and where distinctive interactional contours have developed. We use the term *interactional topography* to describe this, based on the assumption that there will be many different landscapes of interaction, that some features of these change over time while others endure and that these characteristic features of the landscape will be indicative of Frey's (1996) 'deep structure', just as close examination of distinctive features of the physical landscape will be indicative of deeper geological structures. Applied to interdisciplinary discourse, this combination of interactional mapping (IDLab) and mining (conversation analysis) has allowed us not only to identify important features but to explicate the ways in which they are deployed.

Transcription

Bearing in mind Ochs' (1979: 44) injunction in her seminal paper on transcription that transcripts should not have too much information, talk was initially transcribed at the most basic level, capturing the words spoken but with no indication of features such as overlap, emphasis, and so on. Close listening allowed these to be included, though in order to preserve the integrity of the text for the purposes of analysis using the IDLab it was not possible to attempt a full transcription based on the system developed by Jefferson (1989) and used by conversation analysts. This was also a practical decision since detailed transcription is extremely time-consuming, though in all cases where detailed analysis was involved this included detailed transcription. The Jefferson system (slightly adapted) used for close analysis in the chapters that follow is represented in Courier New, but for ease of reading and in order to conserve space a basic transcript, which appears in the same font as the main text, is included as a basis for more general claims. Details of these can be found in Appendix 1 along with a research note.

Important though transcription is, it should be emphasised that analysis was based on the recordings themselves and that the transcript is a theorised representation of these. As Green et al. (1997: 172) observe, transcription 'reflects a discipline's conventions as well as a researcher's conceptualization of a phenomenon, purposes for the research, theories guiding data collection and analysis, and programmatic goals'; it represents the recordings as accurately as possible, but it is not a substitute for them.

Data Set

Data comprised audio-recorded interdisciplinary research project meetings varying in length from one to eight hours and involving researchers from a wide range of disciplines as diverse as biology, art history, law, engineering, physics, education, statistics, politics and medicine. The activities involved ranged from regular meetings of an interdisciplinary team engaged in a funded project to a meeting lasting a day and drawing researchers from different disciplines and different institutions. Details of the projects represented in this book are shown in Table 4.1 below.

Table 4.1 Data used in this book

Project	Recording (minutes)	Transcript (words)
Climate and security	226	41,961
History	269	43,127
Livestock governance	210	21,699
WSBLH*	1212	207,510
WSBCH	383	28,237
WSBPR	332	46,924
WSBNF	254	33,590
WSBRE	115	21,745
TOTAL	3001 (50 h 1 m)	444,793

*All five WSB-prefaced entries are distinct projects involving different teams but falling within systems biology. For an explanation of the predominance of these, see below.

The full data set from which the data in Table 4.1 are taken comprises over 400 hours of audio recordings. The advantages of video recordings do not have to be spelled out, but this was not an option because participants were uncomfortable with the prospect of being filmed. The lack of video evidence has no impact on analysis using the IDLab, but it has to be seen as a limitation, however minor, in the case of more detailed analysis.

As Table 4.1 shows, the data set is not 'balanced' in the sense that all disciplines are equally represented, but the decision to place particular emphasis on systems biology (prefaced by 'WSB' in the project titles) was deliberate, partly because this is an emerging discipline (or an established interdiscipline) and therefore offers an interesting evolutionary point as a context for investigation, and partly because of the special status of biology in the context of interdisciplinarity. The National Science Foundation identifies biology as having the highest cross-disciplinary citation rate (38.3%), which makes it particularly worthy of study.

Conclusion

This chapter has presented rationale for the approach adopted in the four analytical chapters that follow, but we hope it has done more than that. Research on interdisciplinarity is by now well established and is able to provide a rich fund of insights into the nature of this important development. However, we have tried to show that research to date has relied heavily on interview data and has not fully appreciated the limitations of this. We have therefore suggested ways in which the findings already available might be supplemented—and potentially challenged—by other approaches offering fresh perspectives on familiar territory. The chapters that follow are designed to indicate the sort of contribution that one such approach can make.

References

Aijmer, K. & Stenström, A-B. (2006). Approaches to spoken interaction. *Journal of Pragmatics*, *37*, 1743–1751.

Akkerman, S., Admiraal, W., Simons, R. J., & Niessen, T. (2006). Considering diversity: Multivoicedness in international academic collaboration. *Culture & Psychology, 12*(4), 461–485.

Amey, M. J., & Brown, D. F. (2005). Interdisciplinary collaboration and academic work: A case study of a university partnership. *New Directions for Teaching and Learning, 102*, 23–35.

Antaki, C. (2008). Discourse analysis and conversation analysis. In P. Alasuutari, L. Bickman, & J. Brannan (Eds.), *The Sage handbook of social research methods* (pp. 431–446). London: Sage.

Bauer, H. H. (1990). Barriers against interdisciplinarity: Implications for studies of science, technology, and society (STS). *Science, Technology, and Human Values, 15*, 105–119.

Beers, P. J. & Bots, P. W. G. (2007). Eliciting conceptual models to support interdisciplinary research. Proceedings of the 40th Hawaii international conference on system sciences, 2007. IEEE.

Biber, D., Conrad, S., Reppen, R., Byrd, P., & Helt, M. (2002). Speaking and writing in the university: A multidimensional comparison. *TESOL Quarterly, 36*(1), 9–43.

Bridle, H., Vrieling, A., Cardillo, M., Araya, Y., & Hinojosa, L. (2013). Preparing for an interdisciplinary future: A perspective from early-career researchers. *Futures, 53*, 22–32.

Bromme, R. (2000). Beyond one's own perspective: The psychology of cognitive interdisciplinarity. In P. Weingart & N. Stehr (Eds.), *Practising interdisciplinarity* (pp. 115–133). Toronto: University of Toronto Press.

Choi, S. (2016). The case for open source software: The interactional discourse lab. *Applied Linguistics, 37*(1), 100–120.

Choi, S., & Richards, K. (2012). Turn-taking in interdisciplinary scientific research meetings: Using 'R' for a simple and flexible tagging system. In M. Haugh, S. Ruhi, T. Schmidt, & K. Wörner (Eds.), *Best practices for speech corpora in linguistic research* (pp. 37–42). Ankara: Middle East Technical University.

Clark, H. H. (1996). *Using language*. Cambridge: Cambridge University Press.

Clarke, A. (2005). Commentary 1: Professional theories and institutional interaction. *Communication & Medicine, 2*(2), 189–191.

Copland, F., & Creese, A. (2015). *Linguistic ethnography: Collecting, analysing and presenting data*. London: Sage.

Creamer, E. G. (2005). Insight from multiple disciplinary angles: A case study of an interdisciplinary research team. *New Directions in Teaching and Learning, 102*, 37–44.

Curry, L. A., O'Cathain, A., Plano Clark, V. L., Aroni, R., Fetters, M., & Berg, D. (2012). The role of group dynamics in mixed methods health sciences research teams. *Journal of Mixed Methods Research, 6*(1), 5–20.

della Chiesa, B., Christoph, V., & Hinton, C. (2009). How many brains does it take to build a new light: Knowledge management challenges of a transdisciplinary project. *Mind, Brain, and Education, 3*(1), 17–26.

Donnellon, A. (1996). *Team talk: The power of language in team dynamics*. Boston: Harvard Business School Press.

Drew, P., & Heritage, J. (1992). Introduction. In P. Drew & J. Heritage (Eds.), *Talk at work* (pp. 3–65). Cambridge: Cambridge University Press.

Frey, L. R. (1996). Remembering and 're-membering': A history of theory and research on communication and group decision making. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision making* (2nd ed., pp. 19–51). Thousand Oaks: Sage.

Garvin, T. D. (2012). The challenge of classifying 'interdisciplinary research': An exploration. *Current Research Journal of Social Sciences, 4*(4), 323–331.

Green, J., Franquiz, M., & Dixon, C. (1997). The myth of the objective transcript: Transcribing as a situated act. *TESOL Quarterly, 31*(1), 172–176.

Hemmings, A., Beckett, G., Kennerly, S. & Yap, T. (2013). Building a community of research practice: Intragroup team social dynamics in interdisciplinary mixed methods. *Journal of Mixed Methods Research*, *7*(3), 261–273.

Hepburn, A., & Wiggins, S. (2007). Discursive research: Themes and debates. In A. Hepburn & S. Wiggins (Eds.), *Discursive research in practice: New approaches to psychology and interaction* (pp. 1–28). Cambridge: Cambridge University Press.

Heritage, J. (1995). Conversation analysis: methodological aspects. In U. M. Quasthoff (Ed.), *Aspects of oral communication* (pp. 391–418). Berlin: de Gruyter.

Holbook, J. B. (2013). What is interdisciplinary communication? Reflections on the very idea of disciplinary integration. *Synthese, 190*, 1865–1879.

Housley, W. (2000). Category work and knowledgeability within multidisciplinary team meetings. *Text, 20*(1), 83–107.

Hunt, L. (1994). The virtues of disciplinarity. *Eighteenth-Century Studies, 28*(1), 1–7.

Hurford, J. R., & Heasley, B. (1983). *Semantics: A course book*. Cambridge: Cambridge University Press.

Jefferson, G. (1989). Preliminary notes on a possible metric which provides for a 'standard maximum' silence of approximately one second in conversation. In D. Roger & P. Bull (Eds.), *Conversation* (pp. 166–196). Clevedon: Multilingual Matters.

Kalra, P., & O'Keeffe, J. K. (2011). Communication in mind, brain and education: Making disciplinary differences explicit. *Mind, Brain and Education, 5*(4), 16–171.

Kellert, S. H. (2008). *Borrowed knowledge: Chaos theory and the challenge of learning across disciplines*. Chicago: The University of Chicago Press.

Klein, J. T. (1990). *Interdisciplinarity: History, theory and practice*. Detroit: Wayne State University Press.

Kockelmans, J. J. (1979). Why interdisciplinarity. In J. J. Kockelmans (Ed.), *Interdisciplinarity and higher education* (pp. 123–160). University Park/London: Pennsylvania State University Press.

Lakhani, J., Benzies, K., & Hayden, K. A. (2012). Attributes of interdisciplinary research teams: A comprehensive review of the literature. *Clinical and Investigative Medicine, 35*(5), E260–E265.

Lattuca, L. R. (2001). *Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty*. Nashville: Vanderbilt University Press.

Lau, L., & Pasquani, M. (2008). 'Jack of all trades'? The negotiation of interdisciplinarity within geography. *Geoforum, 39*, 552–560.

Lee, D. Y. W. (2008). Corpora and discourse analysis: New ways of doing old things. In V. K. Bhatia, J. Flowerdew, & R. H. Jones (Eds.), *Advances in discourse studies* (pp. 86–99). London: Routledge.

Lingard, L., Schryer, C. F., Spafford, M. M., & Campbell, S. L. (2007). Negotiating the politics of identity in an interdisciplinary research team. *Qualitative Research, 7*, 501–519.

Lynch, M. (1985). *Art and artefact in laboratory science: A study of shop work and shop talk in a laboratory*. London: Routledge.

Mann, S. (2011). A critical review of qualitative interviews in applied linguistics. *Applied Linguistics, 32*(1), 6–24.

Manor-Binyamini, I. (2011). A model of ethnographic discourse analysis for an interdisciplinary team. *Journal of Pragmatics, 43*, 1997–2011.

Mansilla, V. B. (2008). Patterned diversity in interdisciplinary dialogues: Lessons from an empirical study of interdisciplinary research at the frontier. In F. Darbellay, M. Cockell, J. Billotte, & F. Waldvogel (Eds.), *A vision of transdisciplinarity: Laying foundations for a world knowledge dialogue* (pp. 137–147). Boca Raton: EPFL Press.

McCallin, A. (2004). Pluralistic dialoguing: A theory of interdisciplinary teamworking. *Grounded Theory Review*, *4*(1). http://groundedtheoryreview.com/2004/11/30/1605/. Accessed 24 Feb 2015.

Misra, S., Hall, K., Feng, A., Stipelman, B., & Stokols, D. (2011). Collaborative processes in transdisciplinary research. In M. Kirst, N. Schaefer-McDaniel, S. Hwang, & P. O'Campo (Eds.), *Converging disciplines: A transdisciplinary research approach to urban health problems* (pp. 97–110). New York: Springer.

Moran, J. (2010). *Interdisciplinarity* (2nd ed.). London: Routledge.

Newell, W. H. (2001). A theory of interdisciplinary studies. *Issues In Integrative Studies, 19*, 1–25.

Ochs, E. (1979). Transcription as theory. In E. Ochs & B. B. Schiefflin (Eds.), *Developmental pragmatics* (pp. 43–72). New York: Academic Press.

Ochs, E., & Jacoby, S. (1997). Down to the wire: The cultural clock of physicists and the discourse of consensus. *Language in Society, 26*, 479–505.

Ochs, E., Jacoby, S., & Gonzales, P. (1994). Interpretive journeys: How physicists talk and travel through graphic space. *Configurations, 2*(1), 151–171.

Poole, M. S., & Hirokawa, R. Y. (1996). Introduction: Communication and group decision making. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision making* (2nd ed., pp. 3–18). Thousand Oaks: Sage.

Potter, J., & Hepburn, A. (2005). Qualitative interviews in psychology: Problems and possibilities. *Qualitative Research in Psychology, 2*, 1–27.

Qin, J., Lancaster, F. W., & Allen, B. (1997). Types and levels of interaction in interdisciplinary research in the sciences. *Journal of the American Society for Information Science, 48*(10), 893–916.

Reinalter, H. (1996). Interdisciplinarity in theory and practice. *Journal of Area Studies, 4*(9), 154–158.

Repko, A. F. (2007). Integrating interdisciplinarity: How the theories of common ground and cognitive interdisciplinarity are informing the debate on interdisciplinary integration. *Issues in Integrative Studies, 25*, 1–31.

Richards, K. (2005). Introduction. In K. Richards & P. Seedhouse (Eds.), *Applying conversation analysis* (pp. 1–15). Basingstoke: Palgrave MacMillan.

Roberts, C., & Sarangi, S. (2005). Theme-oriented discourse analysis of medical encounters. *Medical Education, 39*, 632–640.

Robertson, D. W., Martin, D. K., & Singer, P. A. (2003). Interdisciplinary research: Putting methods under the microscope. *BMC Medical Research Methodology, 3*, 20. http://www.biomedcentral.com/1471-2288/3/20. Accessed 15 Feb 14.

Salter, L., & Hearn, A. (1996). *Outside the lines: Issues in interdisciplinary research*. Montreal: McGill-Queen's University Press.

Sarangi, S. (2005). Social interaction, social theory and work-related activities. *Calidoscópio, 3*(3), 160–169.

Schegloff, E. A. (1991). Reflections on talk and social structure. In D. Boden & D. H. Zimmerman (Eds.), *Studies in ethnomethodology and conversation analysis* (pp. 44–70). London: Polity Press.

Schiffrin, D. (1987). Discovering the context of an utterance. *Linguistics, 25*(1), 11–32.

Strathern, M. (2011). An experiment in interdisciplinarity: Proposals and promises. In C. Camic, N. Gross, & N. Lamont (Eds.), *Social knowledge in the making* (pp. 257–282). Chicago: University of Chicago Press.

Strober, M. H. (2011). *Interdisciplinary conversations: Challenging habits of thought*. Stanford: Stanford University Press.

Stubbe, M., Lane, C., Hilder, J., Vine, E., Vine, B., Marra, M., Holmes, J., & Weatherall, A. (2003). Multiple discourse analyses of a workplace interaction. *Discourse Studies, 5*(3), 351–389.

van Dijk, T. A. (2006). Discourse, context and cognition. *Discourse Studies, 8*(1), 159–177.

van Leeuven, T. (2005). Three models of interdisciplinarity. In R. Wodak & P. Chilton (Eds.), *A new agenda in (critical) discourse analysis* (pp. 3–18). Amsterdam: John Benjamins.

Walsh, S., Morton, T., & O'Keefe, A. (2011). Analysing university spoken interaction: A CL/CA approach. *International Journal of Corpus Linguistics, 16*(3), 325–344.

Woods, C. (2007). Researching and developing interdisciplinary teaching: Towards a conceptual framework for classroom communication. *Higher Education, 54*, 853–866.

5

Knowledge Exchange in Initial Meetings

Introduction: How Knowledge Matters

Knowledge is the lifeblood of disciplinarity, implicated at all levels in all aspects of disciplinary work. Membership of a discipline and success within it depend on mastering the ways in which knowledge is acquired, expressed, deployed and exchanged, to the point where these become so deeply embedded that they are taken for granted. As Fuller puts it, 'a discipline is "bounded" by its procedure for adjudicating knowledge claims' (2002: 191). However, acquired facility within familiar boundaries can easily become a liability when interacting with representatives of other disciplines whose knowledge domains may be very different. For interdisciplinary projects to be successful, participants must come to understand sufficiently well the fields of knowledge involved to make collaboration possible, and for this to happen knowledge has to be shared. Understanding how this is achieved must therefore be a primary concern for the study of interdisciplinarity.

This chapter focusses on the ways in which the exchange and negotiation of knowledge feature in interdisciplinary talk, and because knowledge is such a fundamental feature of the process of interdisciplinary

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engagement some of the points raised here are be taken up from the perspective of identity or leadership in later chapters. The emphasis in the chapter is explicitly on the engagement of different epistemic domains and what this contributes to the business of getting interdisciplinary research done in initial meetings. As a foundation for this, we begin with a brief introduction to work on epistemics in talk.

Epistemics in Talk

The pioneering work of Heritage and Raymond (e.g. 2005) has opened up new lines of enquiry into the ways in which speakers display orientations to knowledge claims and their rights of access to relevant knowledge in interaction. To understand this, it helps to consider the idea of an 'epistemic domain', proposed by Stivers and Rossano (2010: 8) who argued that speakers mark to what extent different things reside within their own field of knowledge. In everyday conversation there are various ways in which I might position myself with respect to my own epistemic domain and those of other participants. If I say I'm hungry, for example, I am displaying knowledge to which only I have access, but if I ask my interlocutors if they are hungry then I am positioning myself as not having the relevant information. In both these cases the epistemic relationship is asymmetrical, but if I remark that the cooking smells good I am making an assessment based on knowledge to which (in normal circumstances) all those present have access.

These apparently very mundane considerations in fact make a great deal of difference to the ways in which subsequent talk is shaped, and the most influential contribution to our understanding of the nature of this has been made by Heritage (2012a), who proposes an 'epistemic gradient' from more knowledgeable (indicated by [K+]) to less knowledgeable [K–]. Statements positioned at the higher end of this gradient, implying 'a claim of primary epistemic and/or moral right' (Heritage and Raymond 2005: 34) are open to challenge. Speakers design their turns to display the nature and extent of their knowledge, from unknowing (e.g. a straightforward question: 'Is it an enzyme?') through having some knowledge (tag question: 'It's an enzyme, isn't it?') to knowing (best guess statement: 'It's an enzyme') and the relative positioning of speakers on this gradient is what Heritage refers to as epistemic status. As we shall see, the extract includes examples of all of these, moving the interaction forward in particular ways.

Heritage's work represents what Drew (2012a, b) has claimed is a 'new agenda' in the field of conversation analysis and is attracting increasing attention, not least because its central claim is that sequences in talk are largely driven by epistemics, predominantly through the way epistemic imbalances or asymmetries are 'levelled off'. That this 'epistemic engine' is sufficiently powerful to drive talk forward in ordinary conversation suggests that in a situation where knowledge itself is the acknowledged currency its relevance will be all the greater. Heritage himself has considered academic territories, which 'embrace what is known, how it is known, and persons' rights and responsibilities to know it' (Heritage 2012a: 6), drawing an important distinction between *epistemic status*, which is a 'relational concept concerning the relative access to some domain of two (or more) persons at some point in time' (p. 4), and *epistemic stance*, which is concerned with how speakers design their turns in talk to position themselves in terms of epistemic status. He points out that while there is often congruence between the two, this is not inevitable and that 'epistemic status can be dissembled by persons who deploy epistemic stance to appear more or less, knowledgeable than they really are' (Heritage 2012b: 33). This is an issue to which we will return later in the chapter. First, though, we provide a detailed analysis of an extract from an interdisciplinary research project meeting that illustrates the importance of epistemics.

Negotiating Knowledge in an Interdisciplinary Meeting

Knowledge is the dominant theme in Extract 5.1. The ways in which it is sought, claimed, displayed and exchanged reveal aspects of the epistemic relationships amongst the participants and reflect features such as their status and their disciplinary affiliation. Although the extract is in some respects unusual, it also serves to illustrate aspects that are central to an analysis of the ways in which knowledge is constructed. It is taken from a meeting to discuss progress in a research project in the area of systems biology, and it involves just three participants. The first speaker, Carl, is a professor of mathematics who is the principle investigator on the project, which involves two universities in the United Kingdom. He has an international reputation and has worked with biologists for long enough to have acquired extensive non-specialist knowledge of their field. His is the host university of this meeting, and the other two participants in the extract are postdoctoral researchers in biology from the other institution.

Also present at the meeting but not appearing in the extract are two specialists in bioinformatics from the host university, one an associate professor, the other a postdoctoral researcher. The other researcher on the project, a professor of biology from Emma and Ben's institution, is not present. The extract, which is taken from about three-quarters of the way through the meeting, begins with a suggestion from Carl about what needs to be done next. The research is focused on ABQC (with the exception of cox[Cyclooxygenase]-2 all identifying references have been changed), and he suggests that attention should focus on the relationship between cox-2 and other genes.

Levels of Knowledge

Extract 5.1(1)

```
01  Carl:  I think the thing we need to know no:w is
02         where the cox (.) two (.) fee:ds (.) back
03         onto >some of the other-< ay bee kew cee driven
04         genes.
05         (1.5)
06  Emma:  °mmmm°
07         (3.8)
08  Carl:  ehhm,
09         (0.4)
10   Ben:  Is there >a way to< predict that without an
11         experiment?
```

```
Carl:  Par↑don?=
 Ben:  Is there any way you can predict that (0.2)
       without using experiments.
       (0.8)
 Ben:  I mean how wudju (0.4) °use° sequences
       maybe.
       (0.5)
Carl:  Well it's a very important gene so
       presumably lots-
       (0.6)
 Ben:  What- ┌(whe-)gene.┐
Carl:        └quite a  lo┘t's known about what-=
Emma:  =°mm°
Carl:  it's downstream genes are.=
 Ben:  =°m°
       (1.8)
Carl:  e:::r (.) TO the transcription factor is
       (.) the-
Emma:  ↓No. Ehhm (0.4) °cox two is not a
       trans┌cription factor.
Carl:       └Oh it's not a
       transcrip┌tion┐ fac°tor°
Emma:           └ No ┘
Emma:  No.
       (0.8)
```

The participants are discussing the progress of an experiment, and we join them as Carl, who is leading the project, identifies a gap in their knowledge that needs to be filled. As we shall see later, there is a very important distinction in systems biology between those researchers who conduct experiments and those who work at their desks, and as a mathematician Carl falls into the latter category. Since their focus is on experiments and this is not Carl's area, his comment is designed to invite a response from the other two participants, both of whom are biologists directly involved in conducting the relevant experiments. Instead of an indication of how this might be determined experimentally, there is a long silence interrupted only by a very quiet 'mmm' from Emma, and it is only when Carl signals that he is about to speak again (l.9) that Ben responds.

What might be expected is a [K+] response to Carl's initiation, but instead Ben asks a question that, by inviting a solution that does not depend on experimentation, shifts the focus from biology back to mathematics. What is at stake here is which discipline will provide the means of obtaining the required knowledge, with Carl inviting a response from the biologists present and, in the absence of such a response, Ben asking a question that calls for an answer from Carl, a mathematician. Ben's repetition of the question following Carl's 'Pardon' (l.12) does not receive a response from the latter, so Ben clarifies his position by suggesting an approach that might work (ll.16–17). Up to now initiations and responses have all been located within relevant disciplinary domains, but Carl now makes knowledge claims that are outside his specialist area.

Although Carl's claim that a lot is known about cox-2 is slightly hedged by 'presumably', his assumption that it is a transcription factor lies at the higher end of the epistemic gradient, implying 'a claim of primary epistemic and/or moral right' (Heritage and Raymond 2005: 34) and is therefore open to challenge. Emma's interruptive and emphatic 'no' in line 30 is nevertheless striking. Interestingly, though, it is not followed by any significant perturbation in the talk, and it is revealing to consider why. There is, as Sacks (1987) noted, a preference for agreement in conversation, and Seedhouse (1997: 554) has shown that even in a classroom situation where the professional responsibility of one party involves providing repair, 'no' tends to be avoided. The construction of any dispreferred turn, such as declining an invitation or disagreeing, is a delicate business with preferred and dispreferred actions characteristically having distinctively different turn shapes: 'preferred actions such as acceptances are normally produced unhesitatingly, without delay, are delivered right at the start of the response turn, are packaged in short turns and are unmitigated…Dispreferred actions are normally produced in variously mitigated or attenuated forms: and they are often accompanied by accounts, explanations, and the like' (Drew 1994: 752). Here, though, there is no mitigation or attenuation: Emma's turn could not be more direct.

Richards has argued (2007) that such unmitigated forms may be found in the talk of professional groups where matters of simple fact are at issue, but where professional issues are involved delicate negotiation is called for. In Extract 5.2, for example, during a weekly meeting of English teachers Louise suggests an answer (l.2) that is incorrect, and Paul's response to this is managed with great delicacy, avoiding explicit rejection while nevertheless indicating that there is a problem with the suggested form. It begins with a hesitation marker signalling a trouble source (l.3), then after a silence of 1.5 seconds agreement followed immediately by the disagreement marker 'well'. Following an alternative proposed by Annette (just 'none'), Paul then offers an assessment of Louise's position, not addressed directly to her, couched in very general terms ('a dodgy area') and followed by 'I think' (ll.10–12). Finally (ll.14–16) he deflects the criticism to another source (a coursebook) upgrading it ('extremely dodgy') and shifting its focus (to a definition of the word 'none').

Extract 5.2

```
Annette:  Mmm
 Louise:  Or 'He smokes none.'
   Paul:  E:m
  Jenny:  °Uhuh°
          (1.5)
   Paul:  Yeah. (.) Well=
Annette:  =Or (none)
 Louise:  Mmm
Annette:  (xxxxxxxxxxxxx) Yeah=
   Paul:  =That's a that's a ┌a (.)┐ dodgy=
Annette:                     └Yeah ┘
   Paul:  =area >I think<=
 Louise:  =Yes.
   Paul:  You should see the explanation
          for 'none' in (.) 'Intermediate
          Matters', it's extremely dodgy.
  Jenny:  Uhuh
Annette:  ┌┌Mmm
   Paul:  └└Em
          (0.6)
```

```
   Paul:  it says 'none' means 'not any'.
          And 'no' means 'not any'.
Annette:  Mmm
   Paul:  hhhhh
 Louise:  °Right.°
  Jenny:  Uhuh.
```

The contrast between this and Emma's response could not be more marked, but there is an important difference between the two groups: in Extract 5.2 all those present belong to the same profession and are expected to be familiar with the same fund of basic specialist knowledge, whereas two different specialisms are engaged in the exchanges in Extract 5.1, so the funds of knowledge, and epistemic rights associated with this, are different. Carl has accumulated a fund of biological knowledge over the years, but he is nevertheless a mathematician and when he makes a claim that is inaccurate, Emma's epistemic rights to the relevant knowledge provide grounds for her response in which the word 'No' precedes a filler and a short pause and then an explicit rejection of Carl's claim: 'cox two is not a transcription factor'.

Carl's reception of this is interesting. He makes no attempt to challenge Emma's correction but instead accepts it immediately. In fact, as soon as he is able to project the completion of her turn, he overlaps her talk with 'Oh', a 'change-of-state token' (Heritage 1984) that signals a shift in his understanding, and then a restatement of Emma's correction: 'it's not a transcription factor'. The fact that her response has been treated as unexceptional is important because it illustrates the very special status of epistemic domains in this talk. There are a number of factors that might influence how Emma designs her turn, any one of which might have produced a different outcome, but considerations such as status (professor and postdoctoral researcher represent the two ends of the academic ladder), hierarchy (Carl is the leader of the project), experience (Emma is setting out on her career while Carl has an international reputation), age (Carl is significantly older than Emma) and gender are all overridden by the epistemic rights that Emma is able to legitimately claim as a biologist.

Providing a Response

Extract 5.1(2)

Ben:	Works to break down prosta (.) somethin (.)
	glan┌din
Emma:	└pro┌stagla┐ndins yeah=
Ben	└Pardon┘
Ben:	=Yeah. KHheh!=
Emma:	=Yeah.=
Ben:	=I've read it but I can't remember it.=
Carl:	=It does what?
	(0.6)
Ben:	Em
	(0.2)
Emma:	Breaks down (.) prosta- prostag┌land┐in=
Ben:	└Yeah┘
Emma:	=doesn'it.
Ben:	Yeah.
Emma:	Which are-
	(1.4)
Emma:	(°>completely<°) SOrt've! (.)
	impuls┌es in┐ i(x) ┌i(x)i(x)i(x)┐
Ben:	└Yeah ┘ └in (xxxxx) c┘ox two is
	only present in certain cells in the body
	cox one (.) is like (.) the universal one.
Carl:	°Yeah°
Ben:	>So that's why< cox two is like
	im(.)portant,
	(1.4)
Ben:	in some- it's present in some cells it
	breaks down the- (0.7) fat 'n sugar into
	something else.
Emma:	Isn't there a lot of like drugs to sort of
	(0.5)
Ben:	mm hhm
Emma:	eh(x)hh act against cox: (.) two >with it.≤
Ben:	Yeah=
Carl:	But WHY: w- s'what's it doin' I tell y'I
	don't understan' what it's doing.

```
73  Emma:  HHHH!hhhhhh (.) What is it
74         (0.4)
75   Ben:  Wrote it down here somewhere what cox two
76         does.
77         (5.0)
78   Ben:  (°Here°)
79         (3.2)
80   Ben:  ((Quoting from text)) Responsible for
81         formation of BIological mediators called
82         >the< prostin(xxxxx).
83         (1.0)
84  Emma:  Yeah.
            (WSBNF0310-01:40:44)
```

The importance of knowledge in the interaction of this group also emerges clearly, though in a different way, in the talk that follows. After Emma has confirmed Carl's new understanding, Ben and Emma work together to characterise the function of cox-2 (ll.37–43). That this additional information is treated as inadequate by Carl is clear from his question in line 44: 'It does <u>what</u>?' As Wang (2006) has noted, 'Wh-' questions such as this are often used, as here, to stimulate a description or explanation and are generally more open than other forms of question and the remainder of the extract is taken up with Emma and Ben's response to this.

Broadly speaking, their response comprises four steps at the end of which Carl will mark their explanation of the function of cox-2 as inadequate. The first step comprises a repetition by Emma of the statement already made (l.48), in the form of a tag question inviting confirmation from Ben. Normally, the first presentation of a knowledge claim would represent a claim to epistemic priority, but this has already been jointly constructed (ll.37–42) and, as Heritage and Raymond (2005: 34) have observed, 'under positions where both speakers have putatively equal access to a referent state of affairs, first speakers may downgrade initial assessments using a tag question format, while second speakers respond with declaratives. These two practices cooperate to cancel the epistemic implications of the first and second positioned status of their contributions' (Heritage and Raymond 2005: 34). The next step occurs where Emma extends her claim to include reference to the fact that they are 'sort've impulses' but struggles to extend it further (ll.54–55), at which point Ben, having first explained the difference between cox-1 and cox-2, responds directly to Carl's question asking what the latter does. However, Emma's shift to the topic of drugs affecting cox-2 (l.66) prompts Carl to reiterate his question, first as an emphatic 'Why' then reformulated as 'What's it doing', concluding with an explicit statement of his lack of understanding.

Jefferson (1981) has shown that that participants may go to some length to avoid overtly marking a response as inadequate and that considerable delicacy is deployed in pursuing an adequate response, but in this case Carl's statement is emphatic and his insistence on needing to understand is forthright. As we shall see, explicit statements of non-understanding are distributed in interesting and unusual ways in the interdisciplinary exchanges in our data set, but at this point it is necessary only to note that Carl's need to move to a K+ position overrides any social expectations regarding interactional niceties. His statement prompts an immediate shift of stance from Emma from her earlier K+ position to a K–, and the extract concludes with Ben finding and quoting from his notes on the function of cox-2. Identifying or quoting the source of an assertion is normally only brought into play when the validity of a claim is called into question (Pomerantz 1984: 608), but here it is the adequacy of the explanation that is at issue, prompting an action that is unique in the data set.

The previous chapter noted Housley's (2000) claim that a consideration of how knowledge feeds into decision-making needs to be considered alongside an understanding of the interactional features of knowledge exchange, and the analysis of this relatively brief extract has served to illustrate how epistemic rights (deriving from disciplinary affiliation) and responsibilities (to seek or provide information adequate for the purpose of allowing productive discussion to continue) are important determinants of the ways in which talk is shaped. This theme will be taken up in this chapter and the two that follow, and we begin by introducing the idea of levels of engagement in interdisciplinary research.

Levels of Knowledge Engagement

Given the wide range of possible interdisciplinary arrangements, it would be foolish to assume that any single trajectory could capture all possible configurations of knowledge engagement, but there seems to be fairly general agreement on the broad line of development from initial meeting to mature involvement. The model best representing this is that proposed by Amey and Brown (2005: 25) and summarised in Chap. 3, in which the evolution of knowledge engagement moves from 'expert' through 'coordinated' to 'collaborative'. As used by Amey and Brown, knowledge engagement covers both the members' use of disciplinary knowledge and the role they play within the relevant interdisciplinary group. The essential shift in terms of disciplinary expertise, particularly relevant in outreach and consulting work, is from expert to learning facilitator. In terms of the interaction through which engagement is realised, Amey and Brown identify an important shift from the competitive exchanges that reflect a single-discipline orientation in the initial stage to a more group-centred orientation based on a greater understanding of the other disciplines involved and a focus on coordination.

There is evidence from other research that the trajectory proposed by Amey and Brown has considerable traction. The overall model is similar, for example, to the one proposed by MacMynowski (2007), which moves from conflict to transformation via tolerant ambivalence and cooperation and identification, while studies of specific stages confirm elements identified in the model. Most strikingly with respect to Stage 1, a study of the interaction in the first meeting of an interdisciplinary project focusing on evaluating systematic reform by Derry et al. (1997: 9) 'revealed little debate or extensive building by one member on the ideas raised by another'. Elements in Stage 2 have much in common with the features of the 'group consolidation stage' identified by López-Yáñez and Altopiedi (2015) in their study of outstanding research groups in Spain, where knowledge integration and collaboration feature in the context of a shift to greater symmetry in relationships amongst group members.

In view of the fact that the Stage 3 of Amey and Brown's model is to some extent speculative because 'the case group did not fully reach this hypothesized stage' (2005: 28), the analysis that follows focuses primarily on the first two stages while also considering any supporting evidence for the third. It is based on Hamilton et al.'s adaptation of the basic model:

Stage 1: Single-discipline orientated – information exchange but no integration. Disciplines and individuals considered to be competing.

Stage 2: Work still single-discipline focused, but within overall co-ordination. Individuals have more understanding of other disciplines. Competition is replaced by coexistence.

Stage 3: Shared understanding and decision-making occurring in an adaptive team, with increased communication at all levels. Individuals listen and reflect, and are motivated by learning as much as task completion. Coexistence is replaced by integration. (Hamilton et al. 2009: 166, based on Amey and Brown 2005)

The analysis in this chapter and the next throws light on the relationship between Stages 1 and 2, exploring the ways in which knowledge is relationally constructed and how information is represented and exchanged. It also considers whether the Stage 1 is competitive and if so whether any aspects of this competition transfer to the Stage 2.

The Projects

Data used in this and the next chapter are drawn from the data set described in the previous chapter. The two initial meetings were chosen because they shared some important basic characteristics but differed in a number of important ways. Both were first meetings, both drew on a wide range of specialisms and both were of roughly the same length, 4h37m in the case of the history (H) meeting and 4 h57 m for the climate and security (CS) meeting. However, while they drew on different specialisms, in the case of history these shared the same very broad disciplinary orientation, while the climate and security meeting involved a wide range of disparate disciplines. In addition, the genesis of the two meetings differed and they had different aims: while the history meeting took up the opportunities offered by new lines of research demanding wider approach, the climate and security meeting was aimed at using the meeting as the basis for establishing a network and was arranged in response to a major challenge confronting society and sought to identify key issues and lines of action.

The two in-project meetings were chosen because although there were areas of overlap there was also a very important difference. The Governance of Livestock Disease (LG) project and WSBLH projects both include strong biological and mathematical elements and include discussions of papers in preparation, but while researchers in the former have come together from different faculties only for the duration of the project, the WSBLH researchers are all systems biologists with a common orientation. This therefore allows comparison between a purely project-based orientation and interaction in the context of an interdiscipline. In light of the latter's place in the evolution of new disciplines, our dataset of projects such as WSBLH is much more extensive than those of other projects. Table 5.1 provides an overview of projects analysed in this and subsequent chapters.

Table 5.1 Overview of projects analysed

	Stage	Purpose	Topic	Research areas
H	Initial	Establish network	Material culture and global connections in the early modern period. Focus on object and context	Chinese history, Latin American history, British history, Ottoman history, Mughal history, art history, architectural history, Asian design, Chinese ceramics, costume, historical geography
CS	Initial	Identify key issues and lines of action/ research	Climate change and security	Politics, international studies, sociology, philosophy, social theory, public policy, economics, law, biology, engineering
LH	Mid-project	Progress experiments, plan possible papers		Biology, mathematics, statistics, bioinformatics
LG	Early/ late-project	Discuss papers in preparation	Decision-making frameworks in the management of livestock disease	Biology, political science, law, economics, mathematics

Knowledge Deployment in Initial Meetings

Our aim in this chapter is to consider to what extent the data from the above projects supports the claim that initial meetings are single-discipline orientated, involving information exchange but no integration and with a competitive orientation. In order to do this, we consider knowledge deployment in terms of five aspects that emerged from our analysis of the data: marking my place, telling my territory, making connections and clarifying terminology. We explain how each of these features in initial meetings, and where it is instructive to do so we compare these with engagements within research projects. We also highlight any significant differences between the two exploratory meetings.

Marking My Place

It is perhaps unsurprising that establishing one's disciplinary position or expertise should feature prominently in initial meetings, providing clear evidence of an orientation towards single disciplines, but it is nevertheless interesting to note that what we have called 'marking my place' rarely occurs in the form of a straightforward statement, as in the following: 'We, um, look at, closely at the material culture of this trade in um, um, among the east India companies or private traders' (Melanie, H1110413–00:56:11). It is much more commonly deployed in the context of discussion of a particular topic in order to identify the boundaries of the speaker's knowledge: 'I am only talking about the worlds that I know. So I am familiar with the work that I'm doing in Africa, the US and part of the UN system. I'm not very familiar with what's happening in the EU' (Roger, CS1/2090429–00:24:43). Related to this are instances where the speaker invokes particular orientations in order to explain or justify positions they are taking up in an ongoing debate. In the following, Evan, a philosopher, is participating in a debate on the subject of national responsibility for harmful emissions in which different methods of approaches to measurement have been discussed. He has highlighted the complexities involved and now seeks to explain why he has not taken up a definitive position in the debate:

> What I'm trying to say is that, em, I'm a I'm trying- it's difficult for me to defend a principle which in <u>isolation</u> I disagree with. As I said, I'm a hybrid theorist, so I believe that <u>each</u> of these principles has some … merit. Why? Maybe I'm a constructivist. Why? Because (they) are desperately … <u>driven</u> by these principles if you ask them. They're pulled in different directions. (CS1/2090429-01:53:00)

These features are common to both meetings, but their different aims help explain why pleas for the relevance on the speaker's own research area, explicit or implicit, are absent from the CS data but noticeably present in the history meeting. Since the aim of the CS meeting is to bring together a wide range of disciplines in order to discuss an important contemporary issue with a view to exploring both complementarity and difference, there is no onus on participants to privilege the search for possible synergies over the need to establish relative positions on key issues. By contrast, the emphasis in the history meeting is on complementarity as a foundation for establishing a network of researchers. In the words of the chair, 'history, archaeology, design history, and anthropology, all of these <u>have</u> ehm ways of dealing with <u>objects</u>, and have ehm methodologies on offer, and <u>ideally</u>, we would try and combine those.' As a result, marking one's place often involves making a plea for the relevance of one's own research area implicitly, by reference to another research area. Diane, an economic historian, illustrates this well:

> And the reason why I think it is terribly important is that … economic history gives <u>values</u> of objects in general and the … production statistics, trading and so on and so forth, but an object's <u>value</u>, once it gets into somebody's possession, depends on totally different <u>things</u> to do with memory and family associations and narratives that have sort of been associated with it, which gives the object a specificity, and […] there are lots of people here that know a lot more about these sorts of the things that I do from <u>museums</u>, I mean you know, object history I mean is really important in this sort of research. (H1110413-01:24:00)

Telling My Territory

Telling my territory involves providing details that are predictably knowable by the speaker as a researcher within a specific field by virtue of the fact that they fall within the epistemological parameters of that field. The epistemic authority that derives from this means that such statements are sometimes invited and rarely, if ever, challenged on their content (there are no examples of the latter in the data set). Other participants may, as a matter of fact, be in possession of the same information, but their status as knowers is different. Admissions of ignorance related to matters that are predictably knowable are never challenged, but those falling outside the relevant field, or at least peripheral to it, may be the subject of humorous comment, as when Richard is talking about Rwanda in the CS meeting and another speaker compares it with Wales in size. Richard's admission that he doesn't know how big Wales is provokes laughter amongst the participants and then an observation by Mike, giving rise to even more laughter, that 'It's a serious gap in your knowledge Richard. I don't know how you manage to carve out a professional career for yourself without (xxxx).'

Interestingly, it is the turn length associated with telling my territory that represents the most immediately obvious difference between initial meetings and project meetings: while extended turns are a typical feature of the former, they occur in the latter only when invited. Broadly speaking, there seem to be three ways in which a speaker's knowledge is designed to contribute to the work of the meeting:

Displayed knowledge. Knowledge is presented for the primary purpose of providing to other participants information about the knowledge domain, or aspects of the knowledge domain, that may be relevant to the topic under discussion but are not part of an ongoing debate. In this sense, they are essentially relational, identifying common features or important differences. For this reason they tend to feature more prominently in the history meeting, where participants are seeking to understand one another's work in order to establish links and develop a research network. Susan's contribution is a good example of this:

> You get these Muslims, because they weren't necessarily Turks, who were, er came to Turkey under the exchange of populations act, and who were often simply just told, 'Look, here are some abandoned houses. Make something of it.' And all this meant that there aren't- there are few heirlooms and you know, that's, I have talked about this a good bit with people who like myself work on material culture, and one reason that people give why there are so few heirlooms is that there was a culture of contributing these things, especially after somebody died. And the idea that you keep them for the next generation, apparently wasn't that dominant. [...] so as a result, I mean the whole heirloom culture that Margot was just talking about, I mean I was fascinated, it's it's absolutely great, but it is very specific and we do need to get- to keep in mind that what's true for England or France or Berlin may not may not be true, it's definitely not true for former occupied lands. (Susan, H1110413-01:31:27/01:33:58)

In this turn, Susan describes work that she has done and the specific circumstances accounting for why the heirloom culture that has previously been referred to does not apply in her research context. This does not represent an argument *against* previous claims but a display of knowledge that sets them within a broader and more varied picture and there is no broader argument (e.g. about patterns of heirloom retention) within which it is set.

Deployed Knowledge. Knowledge is deployed as part of an ongoing debate or argument and for the purposes of providing information relevant to the debate or positioning the speaker's own specialist field within it. For example, in the context of a discussion focusing on the connections between climate and population that has moved onto the topic of food production, Roger, who specialises in US climate change policy, provides an overview of the agriculture industry in the United States at the end of an extended contribution outlining a number of practical obstacles to linking climate change and food security:

> And farming in US is a- is a big agricultural business which pretends to be about small family farms but there is, you know, almost none of those and- and the big ones have worked at a set of ... of personal deals, essentially

> with the government over decades. And it's very, very hard, so yeah it's an issue but it's an issue nobody wants to confront because it's seen I think in DC as a- as as a no win, a non-starting agenda. You're going to face fierce resistance and no, and even though everyone thinks it's probably … out of sync with what we need and not sensitive to climate change, nobody knows how to … move it forward. (CS1/2090429-00:52:19)

Like Susan's contribution, this provides information about a particular context, but unlike hers it is presented as part of a specific debate, in this case on the prospects of government action on climate change. It therefore allows participants to situate the United States within this debate as a country where government action on climate change in the context of agricultural production is not currently likely. The difference between displayed and deployed knowledge does not lie in the content of the contribution as such but in its contextual placement. Evan's statement, for example, might look as though it represents a description of his work, but it is in fact a contribution to an argument about the relationship between theorists and policymakers, providing evidence to challenge a claim by another speaker that productive dialogue between them is not possible:

> There are two sorts of people, there are people like me and possibly ((Name)) who … are all philosophers, who are trying to er make their work more relevant and practical, but they're not, they don't want to sacrifice the philosophical theories of it, so there's a limitation on the amount that you reach out to policy makers and there's all what I call activist philosopher […] actually pushing out a lot of stuff on er on section three […] and it does look like they're having some … er some impact. (CS1/2090429-01:47:09)

The balance of displayed and deployed knowledge does suggest a difference between these two initial meetings that is explicable in terms of their different purposes. While participants in the debate on issues in climate change and security can make useful contributions by deploying their specialist knowledge in ways that move the argument forward, the more substantial presence of display in the history meeting reflects a need for participants to understand the range of different fields involved in order to see how their own expertise might fit within the proposed network.

Directed Knowledge. Knowledge is directed at very specific points within an ongoing process of knowledge exchange that builds towards a shared position that is dependent on the different epistemic elements within it. It is distinguished from the other two forms of knowledge by its immediate, situated utility: the knowledge is designed as a specific contribution to the construction of a shared position and has immediate epistemic consequences for subsequent talk. There is no evidence of this form of knowledge in initial meetings, but it features prominently in project meetings and will therefore be considered in detail in the next section.

Making Connections

Where different disciplines are brought together for the first time with a view to collaborating on an interdisciplinary project, it is clear that connections between them will need to be established, even if on the most general level. In the case of history, this is the primary aim of the meeting, as the chair makes clear in a speech of almost exactly 10 minutes following participant introductions and her own presentation on the nature of the project: 'It also seems to us that the material culture objects on the <u>move</u> can only be understood in these kinds of collaborative contexts, so we need people with <u>different</u> and <u>varied</u> disciplinary … em, but also <u>linguistic</u> expertise, em and … we need … multicultural and multilinguister collaborations, um combined <u>with</u> some kind of watertight method of object analysis' (Abigail, H1110413–00:34:21). Other participants draw attention to connections between specific specialisms: 'I really do um, want to try to um, to make those those connections and draw in those who have worked on the um, <u>territorial</u> aspect and also the <u>maritime</u> history aspect of this this trade' (Melanie, H1110413–01:01:19).

Associated with this explicit focus on connections is a recognition of the challenges involved, which emerges in different forms in the meeting. When Claire (H1304003–00:21:26) asks whether it is 'possible to to find some, um, some <u>framing</u> themes that most of us or <u>all</u> of us could identify with, so that we can have a <u>dialogue</u> that goes across our respective disciplines' this feeds into a discussion in which Charles suggests that bringing together people from different disciplines might involve no more than revisiting old territory:

I think there's a grave risk, especially when you're kind of bringing people together, that of … of sailing around certain buoys again, and and you know, there there's a whole ocean that we don't know anything about and it's not that there isn't stuff that that one can do. […] in fact it's the same story. …We keep telling it under different under different headings. And I just feel there might be some newer stories out there. (H3110413-00:24:50)

Susan's very different fears, expressed slightly later in the discussion, arise from the centrifugal forces that such a meeting can generate: 'I have been worried about you know sort of seeing the whole project go in 500 different directions at the same time' (H3110413–01:30:36). Such reservations need to be seen as a predictable and entirely healthy contributions to a meeting designed to establish connections between disciplines. They serve to raise awareness of the challenges implicit in this, and though there are different shades of opinion in the meeting there is no evidence of overt conflict.

The situation is very different in the CS meeting where different perspectives on the same issue are brought to bear. Since the aim here is not explicitly to make connections, these tend to occur incidentally, as different perspectives align, though there are examples of invitations for specific disciplinary perspectives, as with Robin's 'I'll be very interested in your perspective on what the top down view is of the coupling between … climate change which we hear a lot about and population density, population growth, which we hear less about' (CS1/2090429–00:47:01). In a meeting bringing together physical and social sciences, there are also invitations from one side of the divide to the other asking either for indications of what the speaker's group might be able to use or what the speaker's group might be able to contribute:

'I wonder if a sci- the scientists who are here could tell us maybe what they think is missing er … that we could use er short of actually retraining ourselves.' (Evan, CS4/5090429-01:30:04)

'What would you like? I mean what- what what would you like the softies ((brief laugh)) to give you?' (Mike, CS4/5090429-01:33:50)

While there is no evidence in the history meeting of the competition between disciplines and individuals that is a characteristic of Stage 1 in the model proposed by Amey and Brown, this is far from the case in the CS meeting, where differences seem to emerge most starkly out of invitations to make connections such as the ones above or when the issue of integration is raised. Perhaps the most extreme example is to be found in Extract 5.3, which begins when Mike, chair of the meeting and a social scientist, introduces 'the next point' in the discussion, an invitation for a participant to speak from 'a scientific angle' with a view to making the forgoing discussion, dominated by social scientists, 'more relevant':

Extract 5.3

Mike: So the next point is what we need to inject, the question what
we need to inject from a scientific angle to make what's been
said … here more relevant.
(3.5)
Martin: With- the the perception I I think I- I fully agree with Evan,
because usually the the perception in the the social sciences is, if
we knew what is technically possible and scientifically possible
within the parameters that we have about climate change and
environment controlling the environment and so on, then with
with we could work out the the ethical implications, you know
where costs lie, the political- the politics and the economics of it.
Whereas- … and we can't quite figure out why you need the
ethical … ins and outs in order to figure out the technicality,
because eh reducing carbon emissions a- at least in our world
means … reducing carbon emissions. So if you can devise a
machine, the machine is morally neutral. We'll we'll … We'll see
later who pays for it, but technically speaking
(0.5)
Evan: Well that's just nonsense. I mean I may [well dream that,
[((Laughter))
Mike: You're saying- … You're saying what other people think.
Martin: Yeah.
Mike: Yeah right.
Martin: Yeah.
Evan: Because the the way that the I mean it's not just philosophers
who think this.
(CS4/5090429-01:36:19)

The invitation is taken up by Martin, an engineer, who says that he agrees with Evan, a philosopher, then summarises what he understands to be the position taken up by social scientists that with the relevant technical information it would be possible to work out the ethical implications of technological intervention. He then appears to reverse the direction of the argument (l.12), explaining that engineers can't understand why ethical considerations are necessary to reach technical decisions. Following this (ll.14–15) he makes a statement about carbon emissions that represents them as a technical fact, shorn of ethical associations. In this context, the production of a machine (implicitly a machine to reduce carbon emissions) would be a morally neutral act. He notes that payment might subsequently be an issue and is returning to the technical perspective when Evan interrupts him following a short pause.

In fact, instead of taking up Mike's invitation to 'make' the findings of social scientists more relevant, Martin questions the relevance of the sort of ethical considerations that characterise a social science approach. Instead, he recommends simply adopting a technical approach, framing his response in a way that underlines the distinctness of the two approaches. There is an important shift from the inclusive 'we' in line 8 ('people in general') to an exclusive 'we' in line 12, where it is contrasted with 'you'. In the context of the distinction he has already made, the former must refer to scientists (though the subsequent reference to technical work suggests that the reference might be to a narrower subfield) and the latter to social scientists. The separation between the two is drawn in more emphatic and fundamental terms by his references to '<u>our</u> world', with the emphasis on the first word. His subsequent ethical conflation of the scientific act of developing the machine with its product, the machine itself, in fact represents an implicit rejection of the ethical dimension in science, and it may be this that provokes the turn that follows.

As Kotthoff (1993) has pointed out, unmodulated dissent is not usually found in the first dissent turn of an argument sequence, which is what follows in line 19, but Evan's evaluation displays none of the mitigation that typically characterises a dispreferred response. His emphatic dismissal represents a direct threat to Martin's academic face, and the laughter prompted by his subsequent reference to what he might dream serves only to increase the potential impact of this.

The chair's immediate intervention in line 21 seems to be designed to redirect the force of this by casting Martin as merely the *animator* of the talk, that is the person actually uttering the words, rather than the *principal*, 'the party to whose position, stand, and belief the words attest' (Goffman 1981: 226), a representation that Martin immediately accepts (l.22). Evan's assessment is therefore now understood, albeit retrospectively, as directed not at Martin but at an unspecified group whose view he was conveying.

It could be argued that, in the absence of textual evidence confirming its status, Martin's contribution could be seen as a personal one rather than representative of engineers or scientists in general, in which case the disagreement would not necessarily be representative of a broader division within the group. While opposition is a basic characteristic of argument, it should be understood not merely as an act or sequences of acts but in terms of a relationship between participants (O'Keefe and Benoit 1982: 162), and there is evidence elsewhere in the data of divisions just as stark as the one between Evan and Martin but expressing fundamental differences between groups rather than individuals.

One of the most profound disagreements in the discussion emerged in discussions about the link between theory and practice, where divisions were not necessarily along disciplinary lines. Extract 5.4, which provides an example of this, begins with an assessment of the morning's exchanges by Fred, an academic from the engineering department, who has seen little evidence of integration and suggests that this may be because the discussion has centred on theoretical issues:

Extract 5.4

01 Fred: So if I can just make a comment there that-, a comment
02 we were having over lunch and then, and trying to integrate … er
03 different disciplines around the table, and I don't actually see
04 very much see integration and I think one of the reasons why
05 (1.0) perhaps there isn't very much integration is the way we've
06 got to … problems or the way we try and … you know to tackle
07 the problems. And a lot of the discussion has been on the (1.0)
08 the kind of theoretical … abstract … way you would … you would
09 deal with it.

Dick: Yeah and this is just part of this theoretical discussion again from our kind of exercise is that, once we wanted to (answer) the- an honest expression of the fact of that, once we wanted to start this whole exercise of going to the countries and doing these assessments, we try to avoid the scientists, we try to avoid the researchers in the beginning because we felt they have been too much exposed and it's easy with this definition making if they're not theoretical perspectives, that might mislead us when we go into … the countries using this knowledge because that will give the impression to the local authorities that 'Oh they already know what our problem is so what is the benefit of us in terms of response when it comes to implementation. We do not- we have not own er … basically have not owned the er information and assessments so how should it be going now with the implementation. So let's … let's keep- keep away from the science part for the time being, let's go in a practical way on the ground, identify the issues based on our assessments, and then go out and provide the response. I think there's a big gap at the moment, when it comes to science and theory and what is happening in the practical world.

Fred: I- I- I er I profoundly disagree but er … I'll I'll let someone else

Paul: I a- absolutely a hundred per cent disagree with what- everything that you've just said.

Mike: I think you should- I think you owe it to us to sort of expand on that disagreement Paul.

Paul: No I- I- I think a- a conceptual interest is not is not divorced from what happens on the ground. Er em- what I said is that the conceptual interest must not necessarily lead to policy advice. The two of them are completely different.

[…]

Paul: This is not your institutional interest and I understand why you need policy solutions because that's

Dick: Yeah

Paul: that's the hat you're wearing, but from what I'm- where I'm sitting I can I c- … any any attempt to conceptualize or theorise security is- cannot be otherwi- other than empirical.

[…]

it doesn't automatically follow that all theoretical analysis needs to be … ehm by definition … oriented towards providing policies

on the ground, and the case can be made that … what for
example … the concept of human security, it suffers from the
absence of serious conceptual engagement because it was
produced in an institution without enough serious thought
invested in it. And hence it lagged with y- 15 years later …
exactly 15 years later … we still have human security and we still
don't know exactly what it means and we still don't have policies
which are directly eh targeted at at ensuring … that human
security is achieved. And that is not because we don't have the
means, it's because we lack a precise understanding of what it is
and not enough conceptual effort has been invested in that.
(3.0)
Rachel: Does- doesn't that depend, sorry. Doesn't that depend on the
issue, I mean climate change you know … we're talking all day
how this is a relevant issue and how this is happening. Isn't it …
our responsibility as academics to try and come up with some
policy making solutions rather than sit around inventing poxy
concepts.
((Laughter))
Rachel: I mean
Paul: Why why why are concepts poxy?
Rachel: Because they're not- they're not meaningful in the sense that they
can be used. If they can't be [used for the policy making (world),
Paul: [But they are meaningful. We've
just- we've just discussed that the US government, eh the
European Union, the UNDP, everybody's using these concepts.
They can't be poxy. They regulate our lives. … They regulate
what happens in the world at the tiniest … level.
(CS3/4090429-01:08:20/01:10:45/01:11:45)

When Dick responds by proposing that the focus should therefore be on practical issues at the expense of science because of 'a big gap at the moment, when it comes to science and theory' (ll.27–28), Fred notes his profound disagreement but withdraws from the discussion, leaving Paul, a social scientist, to take it up. Once again, the statement is emphatic and unmitigated as Paul upgrades Fred's assessment to 'a hundred per-cent' disagreement with 'everything' Dick has said (ll.31–32). On this occasion, the chair treats Paul's claim as implicative of further talk and makes explicit the obligation on Paul to provide this. In the extended explanation that follows Paul argues that sound conceptual foundations are needed in order for policy to be effective.

While the difference between Dick and Paul may be fundamental, their arguments are carefully articulated over extended turns and, following a general characterisation of his position (ll.35–38), Paul situates his response within his own disciplinary context, identifying Dick as a member of a different community: 'that's the hat you're wearing, but from where I'm sitting' (ll.42–43). He also claims to understand why from Dick's perspective policy solutions are needed. Paul's argument does not receive an immediate response, but when Rachel takes up the argument she implicitly rejects the distinction made by him at the opening of his turn and memberships all the participants as academics with a responsibility to seek 'policy making solutions' (l.63) to a problem they have already identified. But she goes further than this and reconfigures Paul's 'conceptual effort' (l.57) as merely sitting around 'inventing poxy concepts'. This robustly unacademic formulation prompts general laughter and a challenge from Paul to justify her characterisation, which is then taken up.

When exchanges such as this are considered, it is clear that the CS meeting is far more conflictual than the history meeting, but this is merely a reflection of their different purposes: where the latter aims to lay the foundations for a network of collaborating researchers, the CS meeting has been called in order to explore key issues in addressing the relationship between climate change and security, which depends on interrogating different perspectives through engagement in argument. At a more basic level, both meetings seek to explore connections between different disciplines and professional fields, which does not imply that their differences need to be reconciled. It would seem to be more important in Stage 1 to understand more fully the intellectual resources that are in play with a view to seeing how at least some of these might offer the possibility of future interdisciplinary collaboration. The competition that features in Amey and Brown's characterisation is more immediately evident in the CS meeting than the history meeting, but it should not be seen in a negative light; it merely reflects a different form of engagement between different (and potentially competing) disciplines.

Clarifying Terminology

Perhaps the most interesting finding to emerge from an analysis of these two meetings is that terminological differences between the disciplines involved are not to be found. In both meetings there is a clear interest in clarifying definitional issues, as will be illustrated below, but these form part of an engagement with broader issues of interest to all, rather than emerging from a need to understand conceptual and definitional differences. While the data here are drawn from only two meetings, albeit with a reasonably wide spread of disciplines and in each case extended over four hours of talk, which may possibly be exceptions to the norm, it is nevertheless odd that no definitional differences emerge and no effort seems to be made to establish the sort of common vocabulary that so many writers in the field of interdisciplinary research identify as a key aspect. The next chapter will return to this issue and suggest how this difference might be accounted for, but the remainder of this section will provide examples of how definitional concerns are addressed in the two meetings analysed here.

The main point to note is that the importance of definitions is made explicit in both meetings. In fact, in the history meeting as soon as the personal introductions have been completed, the chair, in a turn that she marks as 'first things first', says that she hopes to 'use the day to sharpen our ideas and to create some kind of shared ground where we all can more or less agree about some of those terms. So it strikes me that the two terms that need definition within that are global history, or what global connections might be, and material culture' (H1304001–00:15:59). Just as key terms are treated as important objects of attention in the history meeting, participants in the CS meeting are conscious of the importance of discussing core concepts, so we find James marking a shift in the debate towards this: 'I think we're into <u>another</u> part of the debate here which is an- a rather more <u>fundamental</u> discussion about what- what security actually <u>means</u>' (CS3/4090429–00:03:33).

For the purposes of illustration, two extracts will be taken from a debate that takes place in the CS meeting immediately following a presentation on ethical aspects of climate change policy decisions. The discussion begins by focusing on the actions of states and the problems of deciding on and pursuing effective global policies in the context of diverse circumstances. At an early stage in the discussion Roger, referring to a point made in the presentation, introduces the problem of defining justice, which is relevant because of the competing claims of different states:

> Do we really understand what justice means here? I mean i- it's fine to say the- that that would be the- but do we really know what this means? I mean do we have a good sense … are we anywhere close to defining what justice would require. Because as you point out there are so many different ways of … entering this and thinking about it and some of these things […] a bunch of areas where we sort of sense that that maybe what we'd like is the- is is a fair outcome, a fair set of policies, I'm not sure that we're having a discussion that will ever lead to that. So we end up falling back on things that are sort of analogous, sort of similar, sort of you know able to m- … so we can muddle through the next year, but w- we always [have] a sense of not quite drilling down to what does it mean to … to have the a- … the climate change at a global scale, what does it mean to … to you know re-engineer human beings, what- what are the moral implications of it. So I'm not sure that we understand what justice … means on these fronts anymore. With with the conference that we did when we talked about nuclear weapons and we talked about war, we talked about trade, we talked about … those things. We had a- we had this vast literature and we could say, okay … sure we can spend a lot of time talking about what fair trade is, but we all have a sort of sense about what the elements of that are. Here it's almost like we're in a … a brand new space. (Roger CS1/2090429-01:40:07/01:41:54)

This extract, part of an even longer turn that is typical rather than exceptional in terms of other contributions to the debate, begins with a rhetorical question asking whether 'we' understand justice and moves on to reformulate this twice, first in terms of knowing what it means and then from the perspective of constructing an adequate definition. From an interdisciplinary perspective what is interesting about the argument that follows is that although the difficulty is identified as deriving at least in part from the many different ways of thinking about the concept, there is no suggestion that these are competing or that the challenge might be in any way reduced if different conceptions could be reconciled. It is rather that, despite an extensive literature, understanding remains at the level of intuition ('a sort of sense'), and explanation tends to be framed in terms of analogies. Throughout the first part of the conference, the use of 'we' is inclusive, in contrast to Martin's use of the pronoun in Extract 5.3 to distinguish scientists from social scientists. Where a shift takes towards the end of the extract, it is between fellow participants in a previous conference who shared a sense of what the relevant elements were and the group here, working in 'a brand new space.'

Slightly later in the same discussion Betty broadens the definitional scope to embrace climatic security, suggesting that this might indicate a way out of the impasse:

> Um, I'm thinking, I'm looking at the definition here of climatic security and I'm sort of thinking, what what does he mean? I'm sort of trying to understand what is actually meant by this, and I find it incredibly abstract, so I'm wondering, I mean, my understanding is climate security really is … is not really anything, um, and I guess this is how it differs from climate justice, um, that we say, you know, it is this, but rather we're dependent on states, the UN, the EU and whoever to say what they understand by the term, the- the er security analysts so then to look at well what do they actually mean and then work with these existing concepts. So I'm wondering … if that's the distinction … well one of the distinctions between the two, you know, that one exists in practice, as it happens and the other one is … one that we sort of impose top down as philosophers. And so … I'm wondering then, um, er, what … the group of people you've been working with or that work on similar things you've done such as (xxxxxx xxxxxx) and so on … what they impact they've had in the real world and what you are hoping to achieve. (Betty, CS1/2090429-01:44:52)

Betty's suggestion involves beginning with an analysis of how a particular term is used in practice and working from this, but in raising this she also touches on an issue that divides participants: the relationship between theory and practice and their relative importance (see Extract 5.4). In inviting consideration of 'real world' impact, she implicitly draws a distinction between academic theorising and practice on the ground. It is this distinction between academics and practitioners that emerges as salient in this meeting, rather than differences between disciplines and their understanding of key terms.

A Qualification

This chapter has examined initial meetings where researchers from different disciplines are brought together for the first time in a meeting either to launch a new project or to explore a key topic from different disciplinary perspectives, and it has found similarities between the two. However, these findings need to be qualified by the evidence from initial systems biology research meetings, which are distinctively different. The differences arise from the fact that systems biology is an interdiscipline in which researchers from the different disciplines involved are used to working together and are at least familiar with the range of disciplinary perspectives involved. Using examples from an initial meeting to start work on a new project, we illustrate briefly where some of the most obvious differences are to be found between this and the meetings already considered.

The meeting from which the extracts are taken is the first one involving the full group, though smaller meetings have taken place involving some of those present, as the leader makes clear: 'I guess this is the first … meeting that we have … with all of us and … we had quite a few between us but we haven't seen the … large amounts of different genes and rates of selection' (ABE WSBSY0309–00:04:18). What distinguishes this from the history and climate and security encounters is that its focus is entirely practical: participants are oriented to deciding on the procedures they will adopt in the experiments and analysis, which will involve discussing relevant issues and options.

This produces a text that is visually strikingly different from those examined so far. There are very few turns that could be considered long by comparison with those of other initial meetings and far more evidence of jointly constructed positions. A comparison between Extracts 5.4 and 5.5 illustrates this difference very clearly, the latter chosen because it is an example of one of the longest turns in the systems biology meeting.

Extract 5.5

Owen: Er well ((Name)) he might mention some [work] he got on both=
Lucy: [Yeah]
Owen: =working clusters. … Ehhhhm (1.0) And he comes up with s-
some stuff and then I've tried to compare it to the background,
(1.0) and it wasn't as easy as I thought before because … er

ehhhm ehm because I think it matters … well not think I'm
pretty sure it matters. It's something to do with the (key)
selection … just go with … Oh well … (fix) them genes. This may
be so for the same number as I had in (prosper),
Lucy: Right.
Owen: but what we want the control for is the … (to map the) sequence
in there.
(WSBSY0309-00:05:20)

In Extract 5.5 Owen is describing some work he has done and offering an explanation of why he found this difficult. There are numerous pauses within his turn where other interlocutors might have produced minimal responses or sought to take the floor, but he is allowed to continue uninterrupted until his explanation is virtually complete, at which point Lucy (l.10) inserts an acknowledgement token (Jefferson 1984). The focus on working practices that is evident in Owen's turn is characteristic of the meeting as a whole, and contributions from one speaker are often used as the basis for suggestions or disagreements by another. The final two extracts (Extracts 5.6 and 5.7) in this section illustrate this, the first involving Paul, a dry, and Lucy, a wet.

Extract 5.6

Paul: When you put it on the biostuff website … you get a whole long
list of … hits
Lucy: Yeah.
Paul: But the majority of [these] hits are statistically insignificant.=
[Yeah]
Paul: =You've- you put the random sequence onto the
biostuff [(spread]sheet) yeah
Lucy: [Yeah]
Lucy: Yeah, it's probably the quickest idea is to do the binomial, and
then just (2.0) then just decide the cut off. (1.5) By (3.5) you
know … a combination of score and by eye.
(WSBSY0309-00:13:05)

Throughout the development of Paul's point, Lucy makes her listenership very clear, coming in at the end of it with a proposal as a biologist in response to the situation he has described. Her contribution, from the perspective of a wet, illustrates the essentially collaborative orientation that distinguishes this *interdiscipline* meeting from the two *interdisciplinary* meetings considered earlier. As with initial interdisciplinary meetings, there is also evidence of disagreement in the interdiscipline meeting, but it differs in terms of both orientation and construction. In Extract 5.7, involving two bioinformaticians, Owen responds to a prior claim by Paul by suggesting that things are more complicated than Paul assumes.

Extract 5.7

Owen: That's what I mean it's not as straightforward as that because
… the P values will change between genes.
Paul: Why don't you … (fit it on the sending) against the stable DESL50
genes and you want to find the ten with the best … over
(excitation) from the gene you just pick the- [those (or)
Owen: [I don't want to look
at the ten best, I want to see … I don't want the best ones I want
to see whether they're there or not I don't care if they're the
best.
(2.0)
Paul: Yeah
(1.5)
Lucy: Does it also return the (2.0) the ehr position … in the … the
motif.
Paul: Mm[mmm
Owen: [Ehhhhr
Paul: Yeah
Owen: Yeah it does 'cos it does the the (xxx) sides, you use (xxxx) sides
and that [answers the (xxxxxxx).
Paul: [Mmmm the data structure … yeah
Owen: Ehm
(1.5)
Paul: Because it [has to
Owen: [(Xxxx)will come up with the P value but the P value
will vary between different genes, and so you- you have to pick
… a- some P value that you think is right,
Lucy: Mmm
Owen: and the top P value doesn't do it because it's just a top P value.
And there's always one there.

30 Paul: But the- the problem is that this … this P rate is … is not a score.
31 Owen: Yeah.
32 Paul: So this 0.01 doesn't actually mean that much you have to search
33 in the trans[(xxxx).
34 Owen: [Nah yeah, yeah.
(WSBSY0309-00:10:12)

One crucial difference between these exchanges and those in the initial interdisciplinary meetings is that here the focus is very much on method rather than theory. While participants in the interdisciplinary meetings wrestled with conceptual definitions and differences, here it is matters of procedure that need to be resolved, and it is this that facilitates the second important difference: the constructive use of disagreement as part of a process of collaborative resolution. While such disagreement in the interdisciplinary meetings involved competition at the expense of integration, the disagreement in Extract 5.7 contributes to the development of a shared position. It begins with Owen, who identifies a problem in a previous contribution from Paul, prompting another suggestion from Paul, again rejected by Owen on the basis that his interest lies only in identifying the presence of the relevant genes (ll.6–9). Paul accepts this, and the two then align in constructing a joint response (ll.15–23) to Lucy's question. At this point Owen takes up the argument to explain why top values are not useful, thereby providing support for his position, but this enables Paul to identify a further problem with P-values in general which means that merely identifying them is inadequate. Owen accepts this (ll.31 and 34) and the talk moves on.

Although the speakers in these exchanges disagree with one another, their differences arise from a shared attempt to find the best specification of what they want to discover on the basis of the experiments that will follow. There is no evidence that they are seeking to establish a position that is distinct from that of the other interlocutors; their interactional efforts are instead invested in the collaborative identification of effective procedures. Disciplinary resources are therefore deployed here in a way that is very different from the approach adopted in the initial interdisciplinary meetings.

Conclusion

The analysis in this chapter suggests that Amey and Brown's description of a Stage 1 meeting is fundamentally accurate for meetings designed to bring different disciplines together under a common theme, but that it may not apply to interdisciplines, where familiarity with the conceptual orientations and working practices of other disciplines is the norm. This suggests that in terms of description (and any developmental work arising from this) interdisciplines might need to be treated differently from interdisciplinary projects. What follows focuses on findings related to the latter, in which the contributions of participants proved to be single-discipline orientated and involved information exchange but no integration. There was also evidence in the CS meeting of confrontation if not competition. However, there were clear differences between the meetings, and the analysis cast doubt on at least one common assumption about early interaction in interdisciplinary meetings.

The two meetings discussed in this chapter are initial ones and not strictly speaking part of a project, though the history meeting technically falls within the project brief. Nevertheless, as Curry et al. (2012: 13) point out, a prerequisite for any successful interdisciplinary project is a minimum shared commitment to its overall goal, and this in turn depends on the sort of epistemological groundwork that is evident in the extracts in this chapter. As the analysis revealed, this took different forms in the two meetings. While participants in the debate on issues in climate change and security can make useful contributions by deploying their specialist knowledge in ways that move the argument forward, the more substantial presence of display in the history meeting reflects a need for participants to understand the range of different fields involved in order to see how their own expertise might fit within the proposed network. The consistency with which this orientation was maintained throughout the meetings in turn reflects a shared understanding of the relevant goal and its implications for contributions.

While there is no evidence in the history meeting of the competition between disciplines and individuals that is a characteristic of Stage 1 in

Amey and Brown's model, this is far from the case in the CS meeting, where differences seem to emerge most starkly out of invitations to make the sort of connections that are important if common ground is to be established (e.g. Klein 1990; Newell 2001; Repko 2007). The exchanges here are in line with research findings indicating that disciplinary distance promotes productive discussion (e.g. Rossini and Porter 1984), though there is less evidence to support Oberg's (2009: 407) suggestion that '[i]t seems likely that broad diversity in an interdisciplinary team increases awareness of the need to work toward integration and to learn about disciplines other than one's own.'

Given the extent of robust engagement with conceptual issues in the CS meeting and the ways in which shared understanding was pursued, it hard to accept at face value Bromme's (2000) claim that differences in common ground often emerge from the discovery that participants are using the same concepts with different meanings or using different terms for them. There was no evidence whatsoever of such discoveries (or exchanges that might have prompted them) in the eight hours of talk across these two meetings.

Where differences emerged in the CS meeting they were not along disciplinary lines, and it was to the most contentious topic, the link between theory and practice, that participants most often returned. There is evidence that initial meetings of this sort can produce highly charged exchanges and Strober (2011) provides an example of what she variously describes as a 'quarrel' (p. 33), a 'flare-up' (ibid.) and a 'fight' (p. 34). In it, an economist is highly critical of a talk given by a mathematician and is in turn chastised by a participant from the religious studies department, with the result that he leaves the room and refuses to rejoin the group despite being urged to do so by the seminar leader over the next few days. As Strober demonstrates, this is the outcome of what she calls different 'habits of mind' deriving from different disciplinary practices, and the conditions in the CS meeting were such that a similar outcome was possible. It is at least possible that a factor contributing to a less explosive situation here was that the theory/practice debate produced alignments along other than disciplinary lines and that the only example of a potential interdisciplinary confrontation was quickly defused by the chair (see Extract 5.3).

Perhaps the most surprising outcome of the analysis, given the emphasis that has been placed on it in the literature on interdisciplinarity, is the absence of an evidence of efforts to create a common vocabulary in these meetings. The same situation obtains in project meetings at all stages, and the next chapter will suggest a reason for this, but there are also implications of the findings from these initial meetings. In Chap. 3 we argued that the claim that a first step in interdisciplinary engagement must involve creating a common vocabulary (Repko 2007) is misguided because it is founded on the assumption that an adequate vocabulary can be agreed in advance of establishing the conceptual foundations of this. The emphasis on engagement with core concepts and the investment in exploring and understanding these in both meetings suggests that this criticism is well founded. Chapter 7, which examines interaction in later stages of project meetings, will challenge an even more fundamental assumption about the nature of interdisciplinary collaboration, but first we consider whether there is evidence in our data to support the description of the later stages in interdisciplinary projects provided by Amey and Brown.

References

Amey, M. J., & Brown, D. F. (2005). Interdisciplinary collaboration and academic work: A case study of a university partnership. *New Directions for Teaching and Learning, 102*, 23–35.

Bromme, R. (2000). Beyond one's own perspective: The psychology of cognitive interdisciplinarity. In P. Weingart & N. Stehr (Eds.), *Practising interdisciplinarity* (pp. 115–133). Toronto: University of Toronto Press.

Curry, L. A., O'Cathain, A., Plano Clark, V. L., Aroni, R., Fetters, M., & Berg, D. (2012). The role of group dynamics in mixed methods health sciences research teams. *Journal of Mixed Methods Research, 6*(1), 5–20.

Derry, S. J., DuRussel, L. A., & O'Donnell, A. M. (1997). *Individual and distributed cognitions in interdisciplinary teamwork: A developing case study and emerging theory*. Madison: National Institute for Science Education University of Wisconsin-Madison.

Drew, P. (1994). Conversation analysis. In R. E. Asher (Ed.), *Encyclopedia of language and linguistics* (pp. 749–753). Oxford: Pergamon.

Fuller, S. (2002). *Social epistemology* (2nd ed.). Bloomington: Indiana University Press.

Goffman, E. (1981). *Forms of talk*. Philadelphia: University of Pennsylvania Press.

Hamilton, A., Watson, F., Davies, A. L., & Hanley, N. (2009). Interdisciplinary conversations: The collective model. In S. Sörlin & P. Warde (Eds.), *Nature's end: History and the environment* (pp. 162–187). Basingstoke: Palgrave MacMillan.

Heritage, J. (1984). A change-of-state token and aspects of its sequential placement. In J. M. Atkinson & J. Heritage (Eds.), *Structures of social action: Studies in conversation analysis* (pp. 299–345). Cambridge: Cambridge University Press.

Heritage, J. (2012a). Epistemics in action. Action formation and territories of knowledge. *Research on Language and Social Interaction, 45*(1), 1–29.

Heritage, J. (2012b). The epistemic engine: Sequence organization and territories of knowledge. *Research on Language and Social Interaction, 45*(1), 30–52.

Heritage, J. & Raymond, G. (2005). The terms of agreement: Indexing epistemic authority and subordination in talk-in-interaction. *Social Psychology Quarterly, 68*(1), 15–38.

Housley, W. (2000). Category work and knowledgeability within multidisciplinary team meetings. *Text, 20*(1), 83–107.

Jefferson, G. (1981). The abominable *ne*? An exploration of post-response pursuit of response. In P. Shroder (Ed.), *Sprache der Gegenwaart* (pp. 53–88). Düsseldorf: Pedagogischer Verlag Schwann.

Jefferson, G. (1984). Notes on a systematic deployment of the acknowledgement tokens 'Yeah', and 'Mm Hm'. *Research on Language and Social Interaction, 17*(2), 197–216.

Klein, J. T. (1990). *Interdisciplinarity: History, theory and practice*. Detroit: Wayne State University Press.

Kotthoff, H. (1993). Disagreement and concession in disputes: On the context sensitivity of preference structures. *Language in Society, 22*, 19–216.

López-Yáñez, J., & Altopiedi, M. (2015). Evolution and social dynamics of acknowledged research groups. *Higher Education, 70*, 629–647.

MacMynowski, D. P. (2007). Pausing at the brink of interdisciplinarity: Power and knowledge at the meeting of social and biophysical science. *Ecology and Society, 12*(1): Article 20. http://www.ecologyandsociety.org/vol12/iss1/art20/. Accessed 15 Feb 2014.

Newell, W. H. (2001). A theory of interdisciplinary studies. *Issues In Integrative Studies, 19*, 1–25.

O'Keefe, B. J., & Benoit, P. J. (1982). Children's arguments. In J. R. Cox & C. A. Willard (Eds.), *Advances in argumentation theory and research* (pp. 154–183). Carbondale/Edwardsville: Southern Illinois University Press.

Öberg, G. (2009). Facilitating interdisciplinary work: Using quality assessment to create common ground. *Higher Education, 57*, 405–415.

Pomerantz, A. (1984). Giving a source or basis: The practice in conversation of telling 'how I know'. *Journal of Pragmatics, 8*, 607–625.

Repko, A. F. (2007). Integrating interdisciplinarity: How the theories of common ground and cognitive interdisciplinarity are informing the debate on interdisciplinary integration. *Issues in Integrative Studies, 25*, 1–31.

Richards, K. (2007). Knowing when to 'no': Aspects of alignment in professional relationships. In H. Bowles & P. Seedhouse (Eds.), *Conversation analysis and languages for specific purposes* (pp. 69–98). Bern: Peter Lang.

Rossini, F. A., & Porter, A. L. (1984). Interdisciplinary research: Performance and policy issues. In R. Jurkovich & J. H. P. Paelinck (Eds.), *Problems in interdisciplinary studies* (pp. 26–45). Brookfield: Gower.

Sacks, H. (1987). On the preferences for agreement and contiguity in sequences in conversation. In G. Button & J. R. E. Lee (Eds.), *Talk and social organisation* (pp. 54–69). Clevedon: Multilingual Matters.

Seedhouse, P. (1997). The case of the missing 'no': The relationship between pedagogy and interaction. *Language Learning, 47*(3), 547–583.

Stivers, T., & Rossano, F. (2010). Mobilizing response. *Research on Language and Social Interaction, 43*(1), 3–31.

Strober, M. H. (2011). *Interdisciplinary conversations: Challenging habits of thought*. Stanford: Stanford University Press.

Wang, J. (2006). Questions and the exercise of power. *Discourse and Society, 17*(4), 529–548.

6

The Collaborative Construction of Knowledge

Introduction

This chapter extends the analysis of the previous chapter to the work of project teams, considering this in the light of the model proposed by Amey and Brown and adapted by Hamilton et al. The analysis of interaction in initial meetings provided clear support for their characterisation of Stage 1 talk and the object of this chapter is to consider whether there is evidence to support their Stage 2 and Stage 3 analyses:

Stage 2: Work still single-discipline focused, but within overall co-ordination. Individuals have more understanding of other disciplines. Competition is replaced by coexistence.

Stage 3: Shared understanding and decision-making occurring in an adaptive team, with increased communication at all levels. Individuals listen and reflect, and are motivated by learning as much as task completion. Coexistence is replaced by integration.

(Hamilton et al. 2009: 166, based on Amey and Brown 2005)

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In developing the analysis, no effort will be made to develop a detailed comparison of the interaction in project groups with that in the meetings analysed in Chap. 5 because the contextual circumstances are so different as to make this impractical. Quite apart from the very different objectives of the two sets of meetings, the size of the groups and the relative familiarity of the members would inevitably produce different patterns. However, grossly apparent differences will be noted, and the analysis will extend beyond merely establishing the extent to which project interaction conforms to the descriptions provided in the Amey and Brown model, seeking also to understand the nature of the collaborative interaction involved.

The characteristics identified in Stages 2 and 3 of the model can be applied to the work of collaborative groups, which Donato (2004: 87) distinguishes from 'loosely configured individuals' on the basis of the following:

- A meaningful core activity
- Social relations that develop as a result of jointly constructed goals
- Recognition of individuals as parts of the cooperative activity and acceptance of their contributions in the service of a larger goal
- Coherence in social relations and knowledge 'located and distributed in its members'

The core activity in the case of interdisciplinary research groups is the research project, and the larger goal is the successful completion of this, and although the nature of social relations falls outside the scope of the research in this book, the ways in which knowledge is handled is one of the primary concerns and the focus of this chapter. It begins with an identification of some of the features that make interaction in project meetings distinctive, before moving on to consider a distinctive feature of the talk that is particularly associated with the collaborative construction of shared understanding.

Building Together

This section illustrates some of the ways in which knowledge in project meetings is collaboratively constructed, but it is worth remarking first on an interesting aspect of such collaborative talk: the way that when a question or topic is pursued the epistemic gradient (Heritage 2012a) may be gradually flattened in the progression towards the completion of an explanation. Space precludes a detailed analysis of this, but the following illustrative sequence occurs within a full transcript of 63 lines and represents all three epistemic positions taken up by Roy:

L.1 ff. I just don't understand quite what kind of experiment you want to do…
L.30 ff. So you want to see them in the continuous experiment but not in the (xxx).
L.53 ff. And you do it by PCR with some kit that is available. (WSBNF0310-00:23:47)

All three representations of epistemic stance are presented as statements, but the epistemic gradients they index are very different. The turn that initiates the sequence, beginning with 'I just don't understand' indexes a deeply sloping epistemic gradient between the unknowing (K–) speaker and the two knowledgeable (K+) recipients, but what follows (ll.30 ff.) is a statement of what Roy takes to be the implications of a response just received from Emma and Ben, derivable from his understanding of this and therefore representing a claim to some knowledge. The final statement is a continuation of Emma's prior point that does not invite assessment. Nevertheless, the reference to 'some kit' is indicative of a gap in Roy's knowledge that Emma goes on to fill: 'The kit amplifies up your microRNA that you can extract.'

An epistemic trajectory of this sort is more to be expected where there is a common interest in pursuing a specific goal (the success of an experiment) that depends on shared understanding, so it is hardly surprising that it is absent from initial meetings, where the groups are also larger. However, there is a striking difference between the two meetings in terms of the collaborative talk on which trajectories such as this are built. While knowledge in initial meetings may be displayed for the purposes of exchanging information or deployed in order to advance arguments, in project meetings it is directed to specific points, often as part of a shared construction. Gordon (2003) uses the term 'supportive alignment' to refer to situations where speakers create ties of cooperation and collaboration, and the following examples illustrate how this alignment is constructed. It begins with examples of ways in which responses to questions are often co-constructed then considers how this also applies also in the less likely context of challenges and responses to them.

Co-constructing Responses

Mercer (2000: 31) defines cumulative talk as talk in which 'speakers build on each other's contributions, add information of their own and in a mutually supportive, uncritical way construct shared knowledge and understanding,' and the data are rich with examples of this, as illustrated by Extracts 6.1–6.3 in which participants respond to a question from Sue.

Extract 6.1

```
01   Sue:  Why is it so low in the wild TYpe all the time.
02         (0.7)
03  Mary:  Because it's (0.2) not very highly
04         expressed [the protein.
05  Kate:            [°>uhuh<°
06  Kate:  It's: (0.2) >you know< transcription factors
07         u:sually are not expressed at high levels.
08         (0.8)
09   Sue:  Oka:yh
10  Kate:  Right? So it's not surprIsing to see low
11         expression
12   Sue:  °Mmm°
           (WSBLH0320-00:09:10)
```

Mary's response to Sue's question in Extract 6.1, following a brief pause, begins with a causal connective signalling that the question is being addressed directly. Although it provides the explanation that the question specifically invites, it does not set this within a broader explanatory context. This is supplied by Kate in line 6, building on Mary's point. Sue acknowledges receipt of this in line 9 and, following a check

('Right?'), Kate then uses another causal connective, 'so', in order to link back directly to the low expression ('it' in line 1 refers to the expression) referred to in Sue's question. The same connective is used by Paul in Extract 6.2 as he also extends a response to Sue from Mary.

Extract 6.2

```
 Sue:  In PRActice when you measure how do you actually
       distinguish (0.8) wha- what (0.4) wha- how come-
       how does it come out as >a measurement<.
Mary:  Ehr by NVDC:.
       (0.8)
Mary:  So:[:
 Sue:     [>↓Okay.<
Mary:  Quantitative VDC!
Paul:  So if you want to know the level of the:: of the
       ADDed (0.2) PK then you need to do NVDC against
       five (type) of: the endogenous PK,
Mary:  >Yeah.<
       (WSBLH0320-00:05:39)
```

Here Mary's answer is much shorter and Sue's response (l.7) much more emphatic. The exclamatory extension of the answer that follows this is explicable in terms of the disciplinary differences between them: Mary is speaking as a biologist to Sue, a statistician, and the reference to quantification implies alignment between the process and the latter's expertise, linking back to her reference to measurement. Paul is a bioinformatician, and in providing information about the process he positions himself as someone sharing Mary's K+ epistemic status, while Mary's confirmation (l.12) also asserts her claim to this knowledge.

As representatives of different disciplines, Paul and Mary draw on different—albeit to some extent overlapping—epistemic resources, but where two speakers share the same discipline, co-constructed responses can involve an element of competitive overlap, as is the case in Extract 6.3 (the second line of this comprises a truncated continuation of a prior point by Kate and can be discounted from the analysis).

Extract 6.3

```
01   Sue:  =Sor[ry what is ce ce a]y one ox.
02  Kate:      [ coz (usually) a- ]
03         (0.6)
04  Kate:  °It's [(xxx).°
05  Mary:        [Erm (.) over expresser.
06         (0.4)
07  Kate:  °Right°=
08  Mary:  =So [(there should be (xxx).
09  Kate:      [So just to maximise the chances of
10         detect[ing the (xx]xxxx), (because) so far=
11  Mary:        [So the(xxx)]
12  Kate:  =she's not been able to- to pick it up at a:ll
13         with that antibody.
14         (1.0)
15  Mary:  So just trying teh
16         (0.6)
17  Kate:  Yeah=
18  Mary:  =pick them up the:re (0.3) see'f I can see
19         it.
           (WSBLH0513-00:06:18)
```

Kate and Mary are both in a position to provide K+ responses to Sue's question, and Kate's first response is overlapped by Mary (l.5). The onset of the overlapping extensions that follow Kate's confirmation of Mary's answer (ll.8 and 9) is almost simultaneous, and part of Kate's longer turn is lost in interruptive talk by Mary (l.11). However, this brief competitive exchange is immediately followed by a jointly constructed explanation of what Mary is currently attempting in the experiment. Kate begins by explaining why Mary has used the over-expresser, and Mary then reformulates this (l.15), initiating her turn with an echo of Kate's 'so' in line 9. In doing so she abandons the response she had begun in line 11 and instead aligns with Kate in a jointly constructed explanation. More explicitly, in using 'them' (l.18) to refer back to Kate's 'the (xxxxxx)' in line 10, Mary situates herself as a 'second speaker' (Sacks 1992: 151), building on Kate's prior turn and not, as earlier, advancing an alternative to it.

What makes these exchanges so different from the ones explored in the previous chapter is the extent to which they are overwhelmingly coproduced, with occurrences of competitive talk eventually resolving themselves into a collaboratively articulated position. The same shared production is evident even in situations where in responding to a question or developing a point a speaker makes an error. In Extract 6.4 the team are discussing Henry's data and have been talking about farmers' responses to TB, when Glenn draws a contrast between this and the situation with BSE, his talk addressed primarily to Henry. The extract begins towards the end of his turn.

Extract 6.4

```
Glenn:   …Some farmers (0.4) dosed their animals to give
         them the symptoms of TB. (0.5) Eh eh:::m=
Henry:   =Yeah
Glenn:   You try and create the symptoms=
Martin:  =OF BSE.
Glenn:   of BSE. Sorry.
         (LG090728-00:59:34)
```

In referring to TB instead of BSE in line 2, Glenn makes a slip, possibly occasioned by the fact that TB has featured prominently in the prior talk. This could result in subsequent misunderstanding or confusion, so it is important that it be repaired. Conversational repair can take a number of forms in a trajectory that begins with a trouble source (in this case the reference to TB) in which a candidate for repair can be found. The options available to the participants are that either the speaker or some other person initiates the repair and that either the speaker or another person does the repairing, though the two may be conflated, as would be the case if Glenn had immediately followed 'TB' with something along the lines of 'sorry BSE'. Otherwise, talk will continue until the repair has been achieved and the trajectory may be completed by an acknowledgement of this by the original speaker. In this case, the completion of the syntactic unit followed by a short pause and a filler (l.2) and then the acknowledgement by Henry means that Glenn has not noticed his slip and is therefore unlikely to repair it; and since he is a leading authority on the spread of diseases in animals, the mistake is clearly not based on ignorance, so this will be a consideration in the design of the repair. In fact, it is achieved through anticipated completion (Lerner 1996) of Glenn's next turn. Martin's repair in line 5 is latched onto Glenn's turn, providing a syntactic completion of it. The repair itself is subtly signalled by the delivery of 'of' with a slight increase in volume and emphasis, the latter prosodically non-standard. Glenn then acknowledges the repair.

What makes the repair here interesting is the way that it is an example of the sort of affiliative talk Sacks (1992: 144–6) associates with collaboratively built sentences. This joint construction also serves to mitigate the fact that this is what Jefferson (1987) has described as exposed rather than embedded correction. In the latter, the speaker undertaking the repair embeds the repaired item in his or her turn (Martin, for example, might have said something like 'Yeah, they try to produce symptoms of BSE' immediately after Henry's turn in line 3), which does not draw attention to the trouble source. Exposed correction, however, makes the trouble source explicit, but in this case Martin's completion produces what is effectively a jointly constructed statement. This may seem a small point, but it is part of a broader pattern of collaborative positioning that is to be found even in exchanges where challenges are involved, as we shall now see.

Responding to Challenges

For obvious reasons, challenges represent a threat to the recipient's face even when their occurrence is part of an agreed approach, so their management is a matter of concern to all parties. In Extract 6.5 the team are interrogating preliminary findings presented by Henry, and it is interesting to see how participants design their contributions to maximise collaborative opportunity.

Extract 6.5

01	Will:	But is your question r- related to the fact that
02		the tests, are in some cases every four years,
03		and that even when they are supposed to be every
04		year, they're often not every year,
05	Henry:	Mhm!=
06	Will:	=because
07	Henry:	Mhm
08	Will:	you know, th- there are often very substantial
09		delays, I mean >for example< one the farms we
10		visited, you know it was receiving threatening
11		letters,
12		(0.4)
13	Henry:	KHhh!=
14	Will:	=°Yeah° em
15	Henry:	°Yea:h°
16	Will:	I mean, they're very reluctant to take these
17		things to cou:rt, but they do often dela:y the
18		occurrence of the t[est
19	Henry:	[Uhuh mm
20	Will:	quite substantially.
21		(1.5)
22	???:	°Mhm°
23	Henry:	Yeah 's (0.2) so it's just-
24		(0.6)
25	Henry:	you know,
26		(1.0)
27	Henry:	that column contai:ns, >you know, the<
28		number of incidents (0.3) reported on farms.
29	Martin:	But that's the number of incidents reported
30		(0.5) in::: (0.2) in that ↓year.
31	Henry:	In that year, yeah.
32		(1.0)
33	Martin:	Ri[ght
34	Will:	[So if the farm wasn't tested in that year,
35		(2.0)

```
36   Henry:  If the farm wasn't tested (0.3) then?
37           ((Sound of sharp intake of breath))
38    Will:  So [ (xxxx xxxx).
39  Martin:     [It won't have any reported incidents.
40   Glenn:  There's a difference between a farm that was
41           tested and found nothing,
42           (1.0)
43   Glenn:  and a farm that wasn't tested, (0.3) and in
44           your data is recorded as::
45   Henry:  As (0.2) as=
46   Glenn:  =As zero.
47   Henry:  As null, [yeah.
48   Glenn:           [Mmhmm.
49   Henry:  Yeah.
50  Martin:  So you'd want- so really you'd want: (0.2)
51           whether or not farmers tested in that year,
52           (0.3) it now has a
53   Henry:  W: we don't have that kind of thing now.
             (LG090728-00:37:00)
```

The extract begins with a contribution from Will (ll.1–20) pointing to a potential problem in the way that Henry's data is recorded. It is framed not as a challenge but as a question about what Henry is asking, and the question is formulated in a way that allows for the possibility that Henry has already recognised the nature of the problem. Will's claim that there are 'substantial delays' is supported by an example from 'one of the farms' Will's team visited as part of this project, and his point concludes (ll.17–20) by repeating that the delays are substantial, implying that the assumption that they take place every year may be unfounded. Throughout the development of this point Henry shows active listenership, but his slightly delayed response to it (ll.23–28) attempts to deflect the challenge by pointing out that the column shows only reported incidents (rather than the results of scheduled tests). At this point Martin provides support for Will's position by pointing out that the basis for calculation is nevertheless the number of incidents reported in each year.

The exchanges between lines 30 and 36 are interesting in terms of how participation is organised. Both of Henry's turns, for example, are examples of what Lerner (1996, 2002) refers to as 'choral co-production', in which a speaker repeats another's utterance. The relevance of this will become more apparent in the discussion of Extract 6.6, but of particular interest here is Will's turn in line 34. Henry's repetition of Martin's 'in that year' serves merely to confirm its accuracy but fails to recognise its implication. Rather than spell this out, Will uses 'So' to indicate that there is a consequence, then completes a subordinate if-clause but does not provide the main clause in which the consequence would be located. Discussing anticipatory completion of others' turns, Lerner (1996) notes that the first speaker may allow a slight pause at a possible completion point to allow another speaker to provide the conclusion, but the two-second pause that follows Will's is double that defined by Jefferson (1989) as a 'standard maximum' silence in conversation, making it clear that Will is not going to provide this. Henry, to whom the turn is addressed, repeats Will's turn but instead of completing it invites other completions ('then?').

Will and Martin both respond to this invitation, but it is Glenn who provides an explanation, using the same format as that of Will. The stretched 's' at the end of his turn in line 44 invites completion by Henry who, as in lines 31 and 36, merely repeats part of the prior speaker's turn (in this case just the final word). Both Glenn's and Will's turn are examples of what Koshik (2002) has called a 'designedly incomplete utterance', inviting completion by the next speaker. In fact, in this case it is the first speaker who has to complete the statement (l.46). When Henry's synonymised repetition of this indicates understanding, Martin goes on to spell out the implication, and the sequence ends with admission by Henry that relevant data has yet to be collected. We can only speculate on the reasons for Henry's failure to provide the expected responses in this sequence, but what is clear is that all of the other participants in the group are involved in creating the possibility of a collective formulation of the problem that involves Henry (Díaz et al. 1996). Although his findings have been challenged, he has been given every opportunity to formulate the challenge himself rather than acting as merely a recipient of it.

In Extract 6.5 only Henry uses repetition, but elsewhere in the data this represents an interactional resource that marks the resolution of differences arising from problems and challenges. Extract 6.6 provides an example of this.

Extract 6.6

```
01  Kate:  What would you expect when you have the unbiased
02         >you know because< they're going to be >all over
03         the place< anyway so they would be (xxx).
04         (0.8)
05  Kate:  So the (xxx) will not necessarily fit in you:r
06         (0.3) probability ↓plot.
07         (2.0)
08  Anne:  Yeah but yeah but it was just sort've (0.6) erm
09         (1.0)
10  Anne:  I just f- w: I mean when we look at the f- erm
11         (0.3) when we look at it it looks quite
12         symmetrical around zero,=so we think
13         a ┌normal distribution might fit it. (0.4)
14   Sue:    └°>mhm<°
15  Anne:  that's why I was jus- in order to check,
16         and it just tells you that (0.2)
17         when you ┌go away from the: (0.4) m- centre
18   Sue:           └(I w-)
19  Anne:  of distribution it's (0.2) not really- (0.2) its
20         no lo:nger really normally distributed.
21   Sue:  Mhm::: (0.2) but the thing is you- (0.2) you
22         don't nee:d (0.2) ┌to t┐ake ┌the distribution=
23  Anne:                    └Mhm ┘     └uhuh
24  Anne:  =Uh┌uh
25   Sue:     └to:
26         (0.6)
27   Sue:  to decide what
28  Anne:  Mhm=
29   Sue:  =is ahm
30  Anne:  Mhm=
31   Sue:  =where- (0.2) what are the outsi:de
32         (0.8)
```

```
33   Sue:  probabilities=
34  Anne:  =Okay=
35   Sue:  =you can just use what you have,
36  Anne:  Okay. Yeah.
37   Sue:  And determine a cut off a[rea.
38  Anne:                           [Uhum: °yeah°
39         (2.0)
           ((Anne and Kate make suggestions))
63   Sue:  Well I [wonder even whether it] (0.2) would be=
64  Anne:         [° (xxx xxx xxxx xxxx)°]
65   Sue:  best to:
66         (1.0)
67   Sue:  work in a two dimensional
68         (1.6)
69   Sue:  thin:g with those plots=
70  Anne:  =Yea::h
71   Sue:  and have (0.2) ehm
72         (1.6)
73   Sue:  >you know< a kind of region where the centre is,
74         (0.5)
75  Anne:  Mhm:
76   Sue:  and anything that is:
77         (0.8)
78   Sue:  out[side
79  Anne:     [Make a circle basica[lly
80   Sue:                          [Make a circle basically
81         yes.
82         (1.0)
83   Sue:  Eh[:m
84  Anne:    [Make a radius.
85  Kate:  °Yeah°
86         (0.8)
87   Sue:  Yeah
           (WSBLH0401-00:37:24)
```

The passage begins with Kate raising a problem with the distribution of Anne's plots (ll.1–6), countered by Anne's suggestion that their symmetricality around zero might allow for a normal distribution and that abnormal distribution occurs further from the centre (ll.8–20). Sue then suggests that it is not necessary to include everything and that it might be possible to determine a cut-off point. This prompts a series of suggestions from Anne and Kate (omitted from the extract) before Sue proposes working with a two-dimensional arrangement, which is accepted by the others. The adoption of Sue's proposal comes in the form of a candidate understanding proposed by Anne in line 79, an interactional move that has been described as representing the organisation of joint action (Goodwin and Goodwin 1987). This is reinforced by Sue's confirmation of Sue's understanding which comes in the form of an overlapping repetition, including the non-essential item 'basically' (ll.79–80). Anne's reformulation in line 84 serves to underline this and prompts agreement from both Kate and Sue, bringing all three participants into alignment.

Repetition, as Tannen notes, 'not only ties parts of discourse to other parts, but it bonds participants to the discourse and to each other, linking individual speakers in a conversation and in relationships' (1989: 51–2; see also Kangasharju 1996). Here and elsewhere in the data it serves to signal epistemic alignment at the end of sequences involving differences between speakers, while at the same time strengthening the collaborative bonds of interdisciplinary team members. In the next section we introduce an even more widely distributed discourse feature that members use in the pursuit of shared understanding.

An Interactional Resource for Building Understanding

In this section we focus on just one verbal feature, the word 'so', showing how it features in the collaborative construction of shared understanding. As we show, it is a pervasive feature of talk in interdisciplinary team meetings, occurring frequently in the turn-initial position, in stark contrast to initial meetings, and it is often deployed strategically in order to establish adequate foundations for proposals or suggestions. We offer this as an example of how a focus on specific discourse features of interdisciplinary talk can throw light on the practices involved in collaborative research. The data are drawn from meetings of different project groups within systems biology, an interdiscipline which is discussed in more detail in the next chapter.

The Discourse Maker 'So'

'So' falls within the category of linguistic features commonly described as discourse markers but also sometimes referred to as discourse particles, discourse connectives or discourse operators (e.g. Redeker 1990, 1991; Fraser 1999; Blakemore 2004; Fischer 2006). They have been variously defined and categorised in different ways, though perhaps the most straightforward is the characterisation offered by Schiffrin, who describes them as 'sequentially dependent elements which bracket units of talk' (1987: 31), providing 'contextual co-ordinates for ongoing talk' (1987: 41). Taken together with Hansen's (1997: 156) observation that they 'prototypically introduce the discourse segments they mark', this provides a sound working description.

As Bolden (2006: 663) has noted, research on 'so' has been surprisingly scarce, focusing mainly on its use for marking inferential or causal connections. Since the consequential use of 'so' has been described as its 'quintessential function' (Lam 2010: 665) and has been noted by a number of researchers (e.g. Blakemore 1988; Fraser 1990; Redeker 1990; Schiffrin 1987), this is hardly surprising, but other studies suggest that it provides a good illustration of what Aijmer (2013: 18) has called the 'indexically rich' aspect of such markers. Johnson's (2002) work on the use of 'so' in police interviews, for example, revealed that 'so'-prefaced questions in interviews introduce topics that serve to direct attention to the relevant agenda. Bolden's work (2008, 2009) also focuses on 'so' as a connective that prefaces topics that are either new or have been abandoned earlier. In what follows we highlight particularly how 'so' sequences preface suggestions or proposals. While much of the research on 'so' has been qualitative, there are examples of studies (e.g. Lam 2009; Buysse 2012) combining both qualitative and quantitative approaches, and in what follows we adopt a similar approach, using quantitative analysis to direct attention to features of particular interest in the talk, contributing to what we have termed an *interactional topography* of the relevant dialogic territory.

While some textual phenomena reveal themselves to the researcher only after deep immersion in the recording and transcript, and others emerge unexpectedly from analysis, some are immediately and grossly apparent.

Such was the case with the word 'so', which was distributed prominently throughout the exchanges, often appearing in unmistakable clusters, as evidenced in previous extracts in this chapter and in Extract 6.7.

Extract 6.7

01	Tim:	…So I've got (…) very briefly (…) mention for <u>Laura,</u> so she's now
02		(…) basically run the first, first few iterations of the (xxxx) dataset
03		so that should start to improve (…) shortly I guess
04	Joan:	So when you say the first few iterations
05	Tim:	So w- we're going to run the (…) first (…) hundred odd genes and
06		then we're going to use the (xxxx) for the [(xxx xxx bits)]
07	Lucy:	[Oh yeah with] one
08		there
09	Tim:	So she's
10	Lucy:	Yeah
11	Tim:	she's running the first <u>batch</u> so now we can (…) next time she
12		runs it we can move faster.
13		(1.5)
14	Tim:	So it should
15	Joan:	So you know what the ideal (xxx) is.
		(WSBPR0526-00:10:58)

Extract 6.7 occurs at the beginning of the meeting business, immediately after Lucy's 'let's start'. It is interesting partly because it's an excellent example of how 'so' tends to cluster in the data set but also because of the way in which all but one of Tim's turns begins with it, with the exception (l.11) being a continuation of an interrupted turn. More interesting yet is the fact that only three of the nine occurrences of 'so' are indisputably causal: lines 3 ('so that should start to improve'), 14 and 15. The other occurrences serve more as markers that the speaker is describing a series of actions or (l.4) asking about these. Such use seems to be very common in the data set, suggesting that the word is often being used for primarily interactional rather than semantic purposes and while nothing approaching the frequency of 'so' in Extract 6.7 can be expected in the full data set, the presence of such sequences nevertheless prompts further investigation.

Our choice of 'so' was determined by its immediately obvious prevalence in the data set and its apparently interactional deployment. While it might have been possible to have examined its distribution throughout the corpus, we decided to focus only on turn-initial occurrences, chiefly because of the importance of the turn-initial position (see, for example, Schegloff 1987; Heritage 2013) but also in view of the fact that the number of instances of this was itself of interest. A basic check on the occurrence of turn-initial occurrences of 'so' (henceforth Tiso), allowing fillers such as 'erm' or 'er' but excluding collocations such as 'and so' or 'yeah so', produced the results presented in Table 6.1.

Topographically, the high proportion of Tisos (an average of 6.74%, representing approximately one occurrence every 15 turns) and the relatively narrow range across all the meetings (between 5.3% and 7.8%) mark these as a distinctive feature of this particular interactional landscape. However, the small number of speakers involved makes it at least possible that the Tiso is an idiosyncratic feature developed over repeated encounters, so we sought out publicly available transcripts of interdisciplinary meetings that might serve as a point of comparison. The search yielded two research group meetings on the MICASE (Michigan Corpus of Academic English) database. One of these, lasting 83 minutes and involving four members of the natural resources research group, took place in a department with no major divisions, so it seems reasonable to assume that the participants were familiar with the relevant disciplinary

Table 6.1 Turn-initial 'so' for participants

Project	Total turns	Turn initial 'so'	Percentage
WSBLH	1754	113	6.44
	1242	94	7.56
	1252	89	7.10
	1443	106	7.34
	1328	82	6.17
WSBCH	1042	72	6.90
WSBNF	976	52	5.32
	875	54	6.17
WSBPR	352	22	6.25
	886	69	7.78
	1415	89	6.28
WSBRE	1391	105	7.54

perspectives. However, the other, a 94-minute meeting of an artificial intelligence research group, involved participants from both physical sciences and engineering and took place in an engineering department with 17 subdivisions, none of them artificial intelligence. In the absence of further information, the identification of the latter as interdisciplinary cannot be conclusive but nevertheless seems reasonable. A comparison of Tisos in the two meetings produced very interesting results (Table 6.2).

While the meeting we had identified as non-interdisciplinary yielded a proportion of Tisos well below the figure in our data, with Tisos featuring on average once in every 76 turns (as opposed to 15), the interdisciplinary meeting produced a figure that was very close to our own (roughly one in every 10 turns). The comparison must be tentative, but it at least suggests that this particular topographical feature is to be found in interdisciplinary meetings more generally.

Mapping the Feature

In order to map aspects of the interaction that contribute to its topography, it is first necessary to tag the data. The limitations of a priori categorisation have been well debated (e.g. Van Rees 1992; Schegloff 2005), so it is important to emphasise that the aim at this point is not to develop a definitive analysis but to generate an indicative map of the relevant interactional terrain. The IDLab tool places no limit on the number of categories used, but a preliminary analysis of the interdisciplinary corpus identified four functions that accounted for all but a handful of Tisos. These we divided into informational and consequential:

Table 6.2 MICASE Turn-initial 'so'

Project	Total turns	Turn initial 'so'	Percentage
Natural resources	835	11	1.32
Artificial intelligence	575	59	8.70

Informational

Check	This aims to understand, clarify, and so on. It establishes that understanding is shared so that discussion can continue, and it may take the form of a question or statement. It is related directly to prior talk and predicts a response confirming or disconfirming the understanding displayed in the check. Hence subsequent turns, or perturbations in the talk arising from their non-occurrence, serve to confirm its status. Distinguishing a check from a consequence can be difficult, but where there is any doubt a turn should be coded as a check if there is evidence of either (dis)confirmation or perturbations in subsequent talk indicating the absence of this. An example of the difference is provided under 'Consequence' below.
Explanation	This fairly broad category comprises anything that serves to explain, account for, provide reasons or motives for (and so on) something. It relates directly to prior talk, generally the previous turn, though where this comprises an explanation it may develop this further or add information to it. It does not predict a next turn, though the recipient of the explanation may display receipt of it. The following provides an example of a check followed by an explanation:

Sue: Why do you mutate them why not take them away
Kate: If you mov- take them away you would alter the spacing of things.

Consequential

Consequence	This expresses the causal relationship between the stated outcome (in terms of actions or states) and prior actions or conditions, both of which are known to the speaker. It does not predict a response and further talk may either

challenge it or build upon it. What distinguishes it from an upshot is that it represents a step or an outcome that arises directly from previous steps or states, is not mediated by interpretive positioning and does not represent a general position. The following extract provides an example of the difference between a check and a consequence:

Ben: I understand why irk could like phosphorelating could <u>affect</u> it but I just don't get why it would affect it in that <u>way</u> where the two and a half minutes in continuous would be so different (…) I get why micro TSAs could be a <u>possibility</u> I just don't see quite how it [(xxxx)

Carl: [The idea the idea presumably could <u>be</u> that erm the that the erm the amount of phosphorelation of the <u>(irk)</u> is proportional to the how long you apply the erm stimulation up to a <u>limit</u> right erm and that erm erm the phosphorelated form say can't work with the RSTP so

Ben: So by phosphorelating you're inhibiting one of the things which interacts

Carl: Yeah

Ben: So you would need to show that irk interacts with the

Carl: So the question would be what it is the data response code irk phosphorelation <u>look</u> like as a function of the erm stimulus period.

(WSBNF0310-00:47:22)

Ben indicates that he does not understand why a particular outcome has been obtained and receives an explanation from Carl. He then checks his understanding of this by offering an explanation of the result of phosphorelating ('you're inhibiting…'). Although this is

	a consequence of the action described by Carl, Carl's response ('Yeah') clearly treats it as a check and by going on to offer a further consequence of this ('So you would need to show…') Ben accepts this. Carl's response this time, in the form of another consequence ('So the question would be…'), builds on Ben's turn rather than confirming his understanding.
Upshot	Upshots express broader consequences, results or implications of prior talk and involve a summary or interpretation of some aspect of that talk. They can be distinguished from consequences because they include an element of interpretation, addressing the question, 'Where does all that leave us?' or 'What does that amount to?' An example of this is the following contribution from Carl: So we really <u>do</u> need to answer this question of how you know what <u>is</u> the effect of the washing genome wide. (WSBNF0415-00:54:11)

When coding, informational functions are treated as primary, so where upshots or consequences serve also as either checks or explanations the instance is coded in terms of the latter.

What emerges most strikingly from this fairly basic mapping of a single feature is the extent to which it reflects features of relevant activities, orientations and relationships. Although all meetings were coded, for the purposes of illustration the analysis that follows concentrates on a single meeting, referring to the full data set where necessary. The IDLab tool generates a number of outputs that can be used for analysis, but implying no specific analytical order. We begin with bar charts providing basic information about Tiso use, highlighting what these indicate, then move on to consider a timeline analysis that sets this basic information into a broader, developmental perspective. Finally, we consider figures providing further details about relationships amongst participants as revealed through their use of Tisos.

It is immediately clear from Fig. 6.1 that Sue's contributions to the talk are less 'balanced' than those of the other participants, with a disproportionately

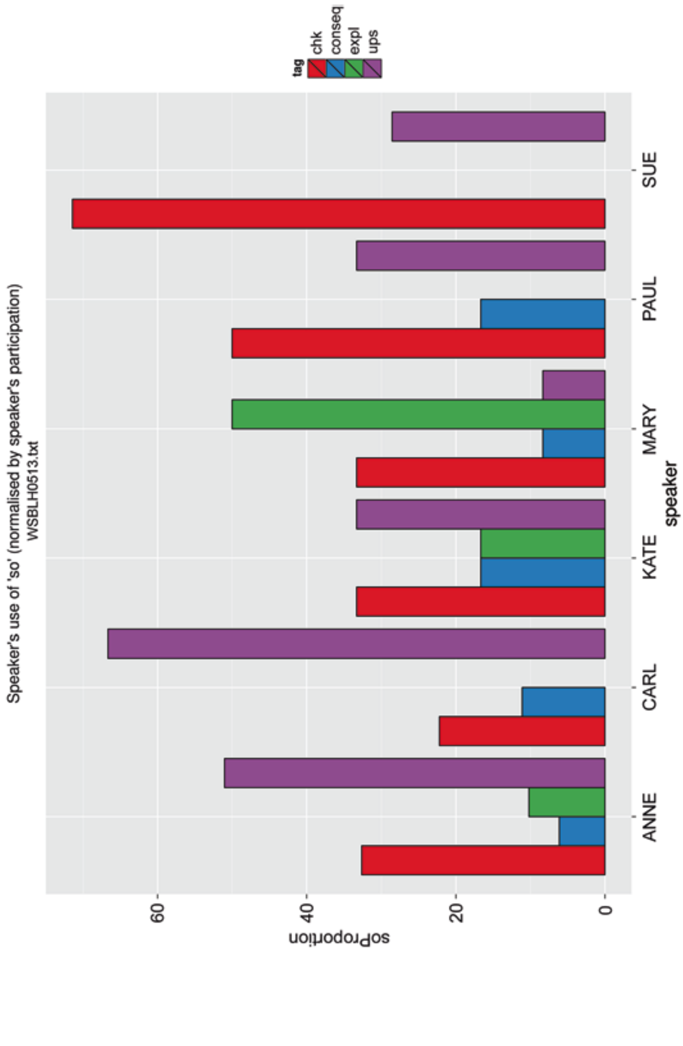

Fig. 6.1 Tiso use by speaker and function (normalised)

large number of checks and no consequences or explanations whatsoever. This is an interesting reflection of her position in the group and the nature of her contribution to the talk. While Sue is not an outsider, as a statistician she could reasonably be described as the least familiar with the experimental aspects of the project. While there is a tradition of mathematicians working closely with biologists (Anne, for example, did a lot of work with biology data in her PhD and is familiar with the field), the introduction of statisticians is a more recent development, and although Sue has worked with a range of biological data she has not worked directly with experimental data. It is therefore not surprising that her use of checks is more extensive than that of other members of the group and that she is not in a position to provide explanations of, or draw consequences from, experimental issues. However, her status as the only statistician in the group makes it almost inevitable that it will fall to her to identify upshots related to her discipline.

The graph also reveals that of the six participants only Anne, Kate and Mary provide explanations, with Mary offering the most, not only in proportion to her turns (Fig. 6.1) but also in absolute terms (Fig. 6.2). This is predictable given the experimental focus of the talk because these three are directly involved in the day-to-day business of the project and are therefore in a position to provide the information needed by the 'dries' seeking to understand how the experiment is progressing. In view of the fact that Anne takes more turns than anyone else in the meeting, and far more than Mary, it may seem surprising that the latter provides far more explanations. However, since these often relate to aspects of the laboratory process and Mary, unlike Anne, is a 'wet', she is best placed to provide explanations of these, in spite of her relatively junior status (she is a post-doc) and the fact that most of the talk has centred around topics more closely related to Anne's work account for the relatively few upshots she contributes. The opposite is the case with Carl, the most senior member present, head of systems biology and a researcher with an international reputation, who in relative terms contributes more upshots than anyone else as the person best placed to assess the relevance and significance of developments in the project.

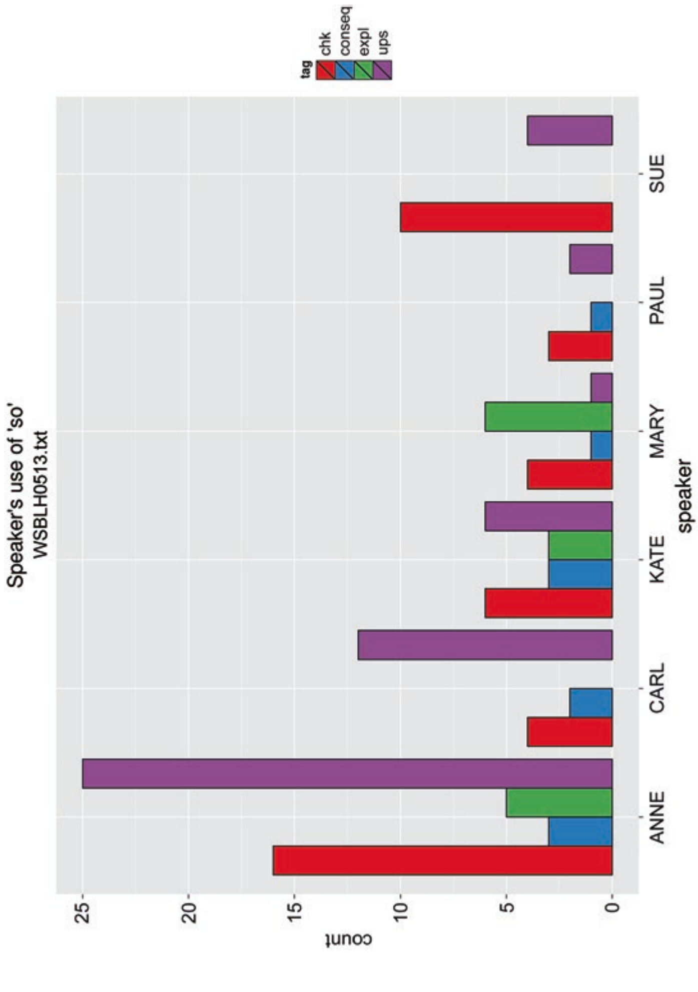

Fig. 6.2 Tiso use by speaker and function (count)

Timeline

The picture provided in Figs. 6.1 and 6.2 is an interesting one, but it is essentially static. A timeline of Tiso use by function and speaker (Fig. 6.3), however, reveals a number of aspects that add important details to the map. Certain features are grossly apparent, the most immediately evident of which are that Anne takes the most Tiso turns and that upshots are more common towards the end than at the beginning of the meeting. Interestingly, Anne's participation analysed in terms of this specific feature is reflected in the extent of her participation overall, as Fig. 6.4 shows. What Figs. 6.1 and 6.2 do not show that emerges here, however, is the way her contributions tend to cluster in the middle, falling away at the end, while Mary's contributions tend to cluster at the beginning and feature hardly at all where Anne dominates.

This reflects the relationship between the two and is also captured in timelines for other meetings. Anne and Mary are both post-docs and are together involved in the ongoing work of the project, but while Mary is a 'wet', doing day-to-day work on the running of the experiment under the supervision of Kate (also a biologist), Anne is a mathematician with experience of working with biological data. Although her primary contact is Mary, she has regular meetings with both Kate and Mary (the 'wet' team) and Sue and Carl (the 'dry' team) and hence serves as a link between them. Anne and Mary occupy the core positions in terms of the developing project, but their contributions are very different, so while there may be occasions where they are both involved in the discussion of a particular issue, it is more likely that one or the other will take the lead, depending on disciplinary focus.

The increase in upshots towards the end of this meeting is a pattern found in the timelines of all meetings, sometimes more obvious than it is here. In fact, examination of talk at the end of this meeting suggests that the distribution is actually more marked than it appears on the timeline because after the last main cluster of upshots (ending at 109) the talk turns to discussion of issues not directly related to the experiment: the work of researchers outside the group, plans for a paper, possible topics for other projects, and so on. It would therefore not be unreasonable to treat the final cluster of upshots as the end of the meeting 'proper'.

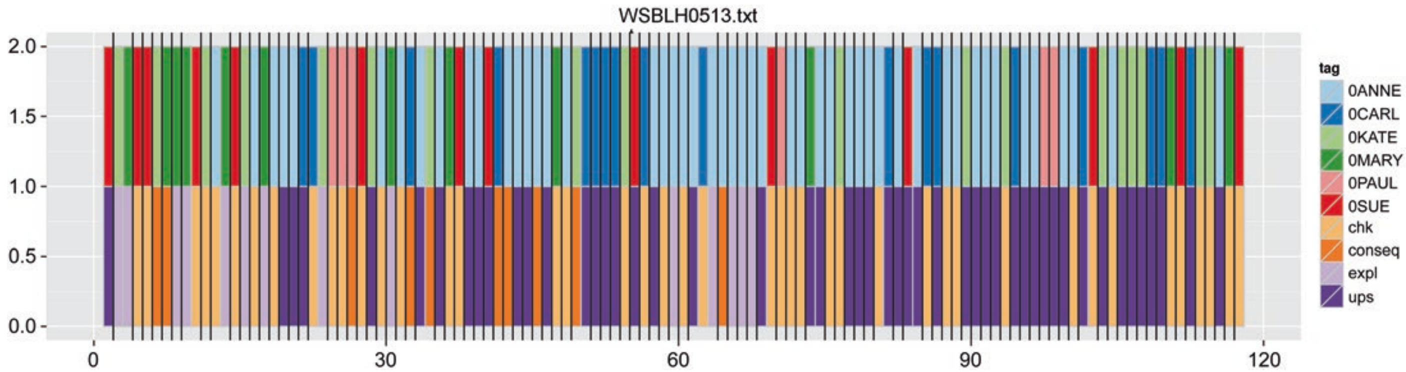

Fig. 6.3 Timeline

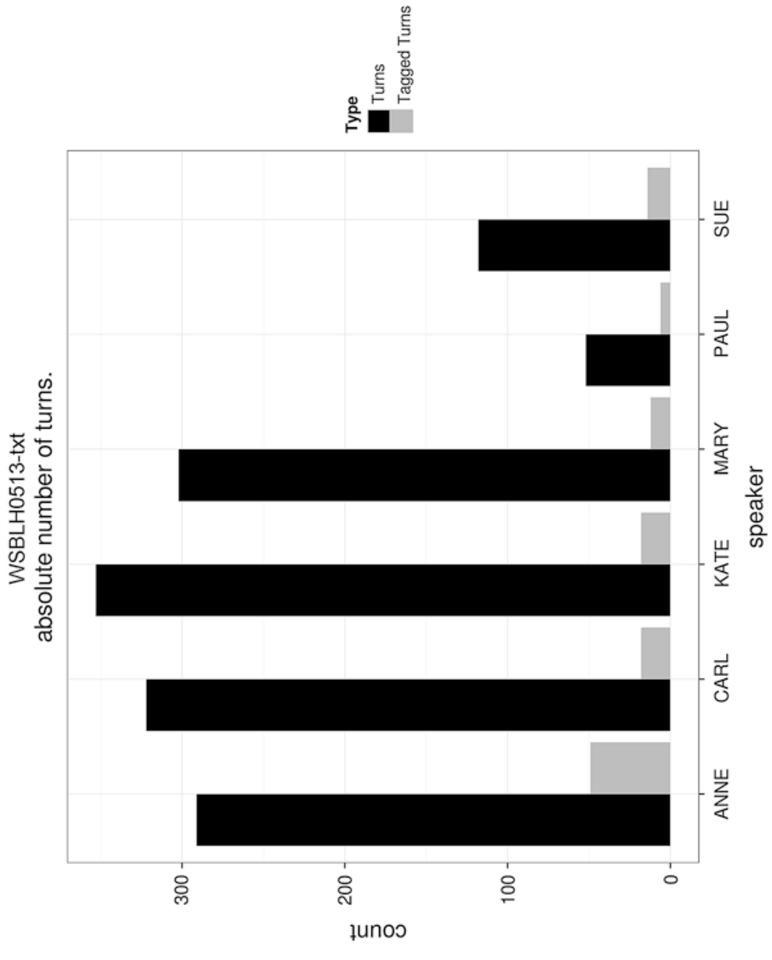

Fig. 6.4 Speaker participation

Other aspects of this timeline also suggest points of interest that bear on how different participants structure their contributions to the talk. Kate's upshots, for example, look unexceptional on the bar charts, but their placement is interesting. They do not appear on the timeline until 89, and the main cluster is towards the end, between 105 and 109. Given her role as the leader of the project, it is natural that she would wish to identify outcomes of the work and draw out the implications of these, perhaps looking ahead to work that needs to be done between now and the next meeting. Also interesting is Kate's relationship with Carl, the other senior figure in the group. Four out of Carl's 11 Tiso turns or turn clusters (e.g. 22–23, 51–54) are followed in the subsequent or next-to-subsequent turn by Kate, and the same applies to the only other meeting where both are present, where 6 out of his 14 turns are followed by contributions from Kate. The two key figures here seem to be working in tandem.

Finally, but perhaps less significantly, Paul's limited contribution to the meeting (Fig. 6.4) comprises just two distinct clusters, a pattern repeated in one of the two other meetings he attended, where there are three clusters and one individual turn, and also present but less strikingly so in the other (two clusters and as well as individual turns). Given that Paul is a bioinformatician working across a range of projects in different disciplines, brought into this project because of his expertise in genetics, his contributions tend to be highly specific, and this seems to be reflected in the distribution of his Tiso turns.

This rough topography can be no more than indicative, but it nevertheless points up features of the interactional landscape that would repay further investigation or which point to the ways in which things are organised and accomplished by the group. The following aspects emerge, for example, from the very basic analysis presented above:

Individual contributions	The fact that Sue's turns are predominantly checks and that she rarely offers consequences or explanations is perfectly explicable in terms of her expected contribution to the project, as is the fact that Paul takes few turns.

Collaborative contributions The distribution of Mary's and Anne's turns reflects their different disciplinary orientation, which requires them to supply different information, and seen as a whole their contributions are complementary. While their turns occupy different positions on the timeline, those of Carl and Kate, working together as the senior members of the team, tend to cluster together.

Leadership As leader of the team, Carl is best placed to assess the wider significance and potential of findings that emerge, which explains the relative dominance of upshots in his contribution. The way in which Kate's upshots occur more frequently towards the end of the meeting also reflects her seniority and experience.

Groups There is some evidence here in the nature of Sue's contributions and the relative infrequency of Paul's that the contributions of dries are more limited than those of wets.

The advantage of this approach is that it allows an assessment of the distribution of the talk in terms of certain basic features, and this can then be set against what is known about the project and the participants in order to see whether any aspects raise questions about the nature of the engagement, perhaps calling for further investigation. In the case of the above, with the exception of the last all the features identified are consistent with what might be expected and suggest that the group is working effectively. However, in a project such as this involving two very different disciplinary groups, wets and dries, it might be expected that the balance of contributions would be fairly evenly balanced, but this seems not to be the case.

In the absence of any clear reasons for this, an explanation can be sought through a closer examination of the interaction. This will be taken up in the next chapter, where it will be suggested that assumptions about the nature of collaborative engagement in interdisciplinary work may not be a reliable guide to what actually occurs. The doubts raised in the next chapter, however, need to be set in the context of talk in which participants collaborate closely to build understanding as a basis for progressing the project. The remainder of this chapter shows the important contribution that so-prefaced turns make to this important work.

The So-Sequence

A feature that occurs across the systems biology data is one that we have called a 'so-sequence' since it is marked by a sequence of so-prefaced K– epistemic turns linking an initial question and a closing proposal, suggestion or observation. This is an important resource in enabling members of the group to draw on one another's funds of knowledge as part of a process of developing new ideas and ways forward, and its presence in project meetings provides direct interactional evidence for Amey and Brown's (2005: 27) characterisation of Stage 2 as involving 'more connected work' within 'an active, task-oriented period'.

We have chosen to illustrate this feature with an extract in which one so-sequence is embedded within another and have broken the full extract into three parts, the first and last comprising the 'outer' sequence and the second consisting of the 'inner' sequence. The team have been discussing the outputs from the latest phase of their experiment, and Carl has pointed out that the patterns they can see so far might be 'mathematically quite trivial'. Different suggestions have been proposed for taking the experiment forward and Extract 6.8(1) begins with a question from Carl following suggestions from Ben and Alf.

Extract 6.8(1)

```
Carl:  How- how many genes do we have that are-
       (0.6)
Carl:  are e:m (.) °em°
       (3.0)
Carl:  co:: (.)co- differentially expre:ssed, are >they
       is tha-< it
```

```
07    Ben:  w-=
08   Carl:  =What's that
09   Emma:  Hundred and fourtee:n.
10   Ben?:  °Yeah°
11          (0.5)
12       :  Which ↑one
13   Emma:  Hundred and fourteen.
14          (1.0)
15    Ben:  Was that just for the puls┌es
16   Carl:                           └Oh!=yeah right. the
17          top there (.) ohhkay.
18          (8.0)
            (WSBNF0310-00:57:34)
```

The first extract comprises an extended question-answer-acknowledgement sequence that begins (ll.1–8) with Carl's formulation of the question and ends with his acceptance of the response. A question forms part of a two-part sequence known as an adjacency pair (Schegloff and Sacks 1973) in which the first pair part (the question) predicts a second pair part (an answer). The second pair follows immediately on the first, and its delay or absence is something that needs to be accounted for, but here the three-second delay in line 4 arises because Carl's question is syntactically incomplete. Following Emma's response (l.9), Carl asks for clarification, 'which one' referring to the visual representation of the results, and when Emma repeats her answer Carl emphatically confirms his receipt of this. His turn (l.16) begins with 'Oh', a change-of-state token (Heritage 1984) indexing a shift in epistemic status from K– to K+ followed immediately by confirmation of this ('yeah right') and a statement that he has located the relevant information on the visual. This indicates that the epistemic gap has now closed and the epistemic engine has run its course (Heritage 2012b: 34). The eight-second silence that follows serves to confirm this.

A silence of eight seconds is considerable in almost any context and would normally represent a lapse in the talk between the end of one topic of conversation and the start of another, but the relevant topic here is by no means closed. Carl has introduced his question as part of a sequence of suggestions and in this context this would normally represent the closing of an epistemic gap as a preface to making a further suggestion or comment. This would explain why nobody else takes the floor and why Carl himself eventually speaks, though only to reiterate the figure he has been given. In the absence of a continuation by Carl, Paul asks another question and begins a sequence of the same sort as the one that has now been temporarily suspended. Extract 6.8(2) takes up the exchange.

Extract 6.8(2)

Carl: Hundred and fourtee:n.=

Paul: =Was this a strict criterion

(0.8)

Paul: (°or was there-°)

(0.3)

Roy: N:o:: °not very strict.°

Paul: So you don’t think it’s normal=it’s (.) >it’s significantly more than (xxx) fourteen that’s- that’s really: (0.3) the (norm).

(0.5)

Paul: ·hh

(3.0)

Emma: °mm°

Paul: hh:°::°=

Roy: =I probably could fi::nd more yes:: (.) I mean-

(1.4)

Roy: I didn’t use any strict criteria.

(1.5)

Emma: °mm°=

Roy: =Just tr:=I applied som:e

(1.5)

Roy: °m!(.)hhhh° (0.3) two or three for (.) special, ’n then another (nine,) ·hh

(1.0)

Roy: for the (solute) (.) by high (.) ↓leach

(1.0)

Roy: if I:: (0.4) believe.=

Paul: =mmm (.) yeah.

(0.8)

```
48   Roy:  °An' if° (0.4)°i:┌t's°
49  Paul:                   └So it should be (a bottom)
50         number (.) (°then°)
51         (0.8)
52  Carl:  YEa:h (.) m-
53   Roy:  Depends °you know° (.) if I make it less strict
54         to: °nn° a hundred 'n fifty, °so-°
55         (2.7)
56  Paul:  So if say eighty per cent of them are (thought
57         to) be affected by the (0.4) wash: (0.4) and we
58         did the whole mock wash >micro array< data, it
59         would allow us to identify twenty genes (0.3)
60         that are affected by: (0.3) pul:se,
61         (1.7)
62  Paul:  so we: (0.4) don't know whether that's relevant
63         (°for us°) (0.5) and it's worth (0.5) it's worth
64         finding out.
65         (4.0)
           (WSBNF0310-00:57:58)
```

Paul's enquiry receives a response from Roy, and what follows is an example of what we have labelled a *so-sequence*. Excluding a short inhalation (l.29), a longer exhalation (l.32) and a minimal response (l.46), Paul has four turns (ll.25, 49, 56 and 62), each beginning with 'so' and manifesting the shift from deeper to shallower epistemic gradients discussed at the beginning of the 'Building Together' section above. The first checks Paul's understanding of Roy's reading of the latter's findings, and the explanation that follows prompts another so-prefaced turn from Paul (l.49), this time demonstrating his understanding by stating what Roy's explanation implies. Roy provides an alternative possibility, but this is ignored by Paul, who goes on to make a substantive suggestion about how the experiment might be taken forward. He concludes his proposal with an assertion of the value of the information this would yield.

This illustrates a so-sequence following a trajectory that begins with a question, develops through a series of so-prefaced turns and ends with a suggestion, proposal or observation. The epistemic progression is from K– to K+, and the overall structure is not dissimilar to Shegloff's (1980) 'preliminaries to preliminaries', where a speaker will contribute a preliminary question or request that projects a later question. The preliminary question is then followed by a series of statements or questions designed to provide the necessary information in order to make the question comprehensible. The initial question and subsequent turns are therefore part of a pre-sequence leading to the question itself. In the case of so-sequences, the elicitation of information serves as a foundation for the suggestion, proposal or observation that concludes the sequence while at the same time involving other members of the team in the steps along the way, making what is an individual proposal the outcome of a collaborative process.

Paul's sequence is embedded within the one Carl began in the first line of Extract 6.8(1) and following the four-second silence that marks its conclusion Carl picks up on his original question with a so-prefaced question in line 66 at the start of Extract 6.8(3).

Extract 6.8(3)

```
66   Carl:  So thes::e hundred an- so how many ay be jay
67          gee (0.4) genes did- (0.2) I mean (0.6) these
68          >are the ones that< are differentially expressed
69          between pulse and continuous,
70   Emma:  °Mm°
71   Carl:  but how many::: ehm genes did we fi:nd that
72          we:re sort've (0.2) ay be (0.3) gee: ay be jay
73          gee contro:lled.
74          (3.0)
75   Emma:  °Uhhum:°=
76    Roy:  =They're (in common in all of this::) Hh!hmw=
77   Carl:  =Well like ┌y'know in  in the:┐ Michigan paper=
78   Emma:             └°(xxxx xxxxx xxx)°┘
79   Carl:  =where he says that there's like you know >I
80          can't remember< the number now: a hundred 'n
81          (1.0)
82   Carl:  twen- fifty or whatever
83          (1.5)
84   Carl:  but what we: reckon
85          (3.2)
86   Emma:  You mean- >would you have to-< (0.3) sort've
87          search for bindings like >to (xxxx) you know<
```

```
               (0.2) the promoters >jus to< check if: like=
       Carl:   NO No no: I mean eh:m: (0.5) y'know Michiga::n
               (0.2) sort of said that- (0.3) when he did that
               experimen:t, where he (0.3) you know basically
               just a micro array experiment [on a:] (0.8) he=
       Emma:                                 [MMm! ]
       Carl:   =he said that we:re a certain number of GEnes
               (1.0)
       Emma:   up regulated.=
       Carl:   =that were up regulated by ay be jay gee and
               >presumably< down ↓down.
       Emma:   °mm°
       Carl:   So wha- er °w° I mean: s: and it wasn't a large
               number of >sort've like a< hundred 'n odd (0.3)
               right? So what is our number for that.
               (1.0)
       Emma:   >°isn't it°< like three thousand or something
               like that.
               (0.8)
       Emma:   Didn't you did it in- (0.4) either two fold or a
               three fold (0.4) increase in the- °(xxx)°
               (0.6)
        Roy:   I think it was about the same number yes::::::
               (0.2) it was a few hundreds::=
       Emma:   =Mm=
        Roy:   =dependent yes two folds (0.5) three fo: [lds
       Carl:                                            [W- So
               >what about-< (0.2) if you take three fold,
               what's the number
               (3.0)
       Carl:   I mean there's [:: did it
       Emma:                  [°I'm a bit°
               (1.5)
       Emma:   °It's on- (0.2) it's on both:. Khh!.hh [hhh°
        Roy:                                          [Yes it's
               probably on the cluster.
       Emma:   KH!heh[eh!
       Carl:         [Mmmm?
```

126 Emma: Heh.HHH!=
127 Carl: =Bu::t (0.3) I mean:: anyway my point really >is
128 that< if it's (0.2) if its >sort've order of a<
129 HU:ndre:d,
130 (2.6)
131 Carl: Eh::m:
132 (3.5)
133 Carl: Then: eh (0.2) the…
(WSBNF0310-00:59:03)

The same sequence is evident here though less obviously so. Carl's opening turn develops from a statement about the nature of the genes into a question about the number controlled by a particular regulator (ll. 66–73). Following a brief response from Roy, he then goes on to provide some background to his thinking (ll.77–84), correcting a mistaken interpretation by Emma (ll.89–98) and pursuing his point about the number in a so-prefaced turn (l.100). When Emma and Roy construct a joint response to this that brings the number close to what Carl has in mind, he follows up with another so-prefaced turn (l.114) asking for a number at three fold. When this line of questioning seems not to yield what Carl expects, he is explicit for the first time about the point he wishes to make ('anyway my point really is that…'), which he goes on to develop over subsequent turns. A trajectory begun with a question about the number of gene co-differentially expressed 133 lines before, and suspended while Paul pursues his own line, finally reaches its conclusion in an extended proposal for a particular line of investigation. Like Paul, Carl does not begin with his proposal but pursues a line of questions and claims that establishes a foundation for this, and in the process involves others in a process of collaborative epistemic exchange.

Conclusion

This chapter has extended the work of the previous one by examining the interaction in project groups. No explicit comparison has been made, in part because the differences are so obvious: so much as a glance at any point in the transcripts, for example, is sufficient to bring home the very big difference in turn length. Having confirmed in Chap. 5 the accuracy of Amey and Brown's (2005) description of Stage 1 in the development of an interdisciplinary group, our aim here was to consider to what extent their Stage 2 description could be applied to the groups in our study. We also wished to see whether there might be further evidence to either confirm or challenge our unexpected finding about the absence of any obvious interest in, or problems with, vocabulary.

The two groups studied are both interdisciplinary and both include mathematicians and biologists, but they differ in at least one respect: while the LG group is made up of researchers from different disciplines coming together for a specific project with no sense of belonging to a shared disciplinary category, the LH team were all systems biologists and hence members of an interdiscipline. In practical terms this means that although as individuals they may be collaborating for the first time, the set of disciplines involved will be standard within systems biology.

What is most striking about these groups is the degree of similarity in the nature of their collaborative engagement and use of interactional resources, though one general difference was evident in their approach. While in the LG group each disciplinary element was responsible for a distinct contribution to the project and presented their findings to the rest of the group for interrogation and discussion, the LH group focused sharply on the experiments that provided data for analysis, bringing their expertise to bear on these in a way that allowed a greater degree of collaboration at a more basic analytical level. In this respect the LG team corresponded more closely to Stage 2 of the Amey and Brown model where '[c]ompeting disciplinary perspectives existed in parallel, allowing tasks to be done independently and brought back to the group for coordination and compilation' (Amey and Brown 2005: 27). This suggests that working practices in projects involving interdisciplines may be different from those employed by participants in interdisciplinary projects, though the interactional achievement of those practices seems to be remarkably similar. As López-Yáñez and Altopiedi (2015: 643) remark, 'different fields of knowledge, research cultures, trajectories, stages, etc. need different group configurations' and the difference in general approach merely reflects this.

There is some evidence, then, that an element in Stage 2 of the model applies to the LG group, but the nature of the engagement revealed by the close analysis of interaction seems much more in line with the integration of Stage 3 of the model than with the coexistence associated with Stage 2. 'Discursive practices', argues Creamer (2005: 41), 'help collaborators move beyond an individualistic or disciplinary stance to one that integrates knowledge from different domains,' and there is strong evidence of such integration from a very early point in these project meetings. The analysis in this chapter has shown how interactional resources are deployed in the process of collaboratively constructing knowledge and understanding. This suggests that although the elements of the last two stages of the model are to be found, the distinction between them is hard to sustain, and it may be more helpful to replace or at least supplement the model with something more fundamental that would enable a clear distinction to be drawn between the nature of knowledge engagement in initial meetings with that in project meetings:

Knowledge State 1: Knowledge constructively exchanged
Knowledge State 2: Knowledge collaboratively constructed

A single-discipline orientation would be possible in either state, allowing for arrangements similar to those in the LG team, because what is important here is not broader orientations or specific features but the epistemic configuration of the engagement. There is no evidence at all in our data, for example, of the motivational shift from Stage 2 to Stage 3 in the Amey and Brown model, to the point where participants are motivated as much by learning as task completion; in fact, the very opposite is the case. With a knowledge-based model such features would be only contingently relevant and not criterial.

Our second point of interest was directed to whether there was evidence in the project meetings of vocabulary issues, and once again there was none whatsoever. This stark contrast between the evidence of our data and the findings of previous research is resolvable in one of three ways: our groups are all radically deviant; our analysis is defective in some way and has therefore failed to reveal what is in fact a pervasive feature of the interaction; the different results are the outcome of methodological differences. Given the range and extent of our database and the extent to which vocabulary problems are claimed to feature, the first is extremely unlikely, and while our analytical skills may not be the most refined we would have to be very lax indeed to miss something as obvious as misunderstandings or perturbations in the talk arising from lexical confusion or uncertainty, so we feel the second is unlikely. There is, however, some evidence pointing to methodological differences as the source of the problem, so we conclude with a brief consideration of this.

Claims about vocabulary problems are based on the research using interviews with researchers involved in interdisciplinary projects, and there is overwhelming evidence that these respondents see terminology as a major stumbling block to interdisciplinary engagement. Can they all be wrong and if so how are they being misled? There are, as we pointed out in Chap. 4, some fundamental problems with research based entirely on interviews, which mean that it has to be approached with considerable care and its findings rigorously interrogated. Careful analysis of the data may reveal, for example, that what interviewees *perceive* to be a problem may on closer inspection turn out to be a way of representing a slightly different, more fundamental but less visible problem. We suggest that this is the case with terminology in interdisciplinary projects and that for those involved it merely indexes deeper and more complex issues.

In order to explain this we begin with an interview-based study that investigated the views of interdisciplinary researchers from broadly the same disciplinary backgrounds as those in our study, in this case systems ecologists and social scientists. For the respondents in Sokolova's interview study the clarification of concepts revealed 'fundamental differences' and she found 'a rift between natural and social scientists, engendered by differences in ontology, epistemology, status conflict, conflict over the area of expertise and explanatory power and applicability of theories' (2012: 46). She provides examples of this, including the following:

> According to Interview 1, social scientists in the project appeared to have a constructivist view of the world as created by individuals, having no fixed rules, and potentially de-constructable. Natural scientists, in the informant's opinion, followed a more positivist perspective, where the world is subject to a stricter classification, and where interactions are defined by a set of rules. (Sokolova 2012: 39)

The general conclusion that Sokolova's informants drew was that ontological differences were irreconcilable and they therefore ended up agreeing to differ. Academics are well aware of these differences and the paradigm wars of the late twentieth century served only to reinforce them (see Bryman 2006), so it is natural that they should be perceived as a challenge to successful interdisciplinary collaboration. In fact, paradigmatic, theoretical and methodological differences do feature in discussions, especially in initial meetings, and these are often framed as terminological matters even though the terminology itself is not the issue.

An illustration of how discussion of a specific term can develop into something more fundamental (which subsequently might be represented as a *terminological* matter) can be found in one of the meetings of the LG group. Jacob, who is leading a discussion of his and Will's draft paper, refers to the second part, where methodological and philosophical issues are examined. He notes that although the relationship between structure and agency represents one of the biggest debates in social sciences, this isn't relevant to the physical sciences. However, he suggests that it might be relevant to work in biology because this deals with live animals. If the structure and agency issue does feature in biology, he suggests, this might represent another potential link between politics and biology. What follows is Glenn's response to this, presented as a monologue with all minimal responses such as 'mhm', 'yeah' and so on removed (there were 41 of these in all):

Extract 6.9

> I suppose I see them essentially as kind of complexity, but you know, complex dynamic systems, that is largely what biology is. And there's this new

> thing called – well it's not that new, but – systems biology which is supposed to look at that complexity to try to understand more about how the cell works, how individuals work and how communities work and, you know, energy flows. And it's very much a dynamic, interactive system, which is quite similar, I think, to what you mean when you talk about agency. You're talking about things that, that have reflexive action on each other. And what that means is that by and large they can be unpredictable. You don't know what's going to happen when you do something over here, and that seems to change something over there, you know. So it's a kind of a – has images back to sort of early chaos theory as well, because of the dynamics. And what that does is I think it creates heterogeneity so it creates differences across the spectrum, and those two things, the self-reflexive dynamic system aspect and the differences, the fact that no-one's the same – and biology, you know, is about differences, largely – means that you can't apply the same rigorous reductionist approach that you can in physics and chemistry. You can only do chemistry and physics because all electrons are the same, or you presume they are. But you can't do that with most biological systems. Biology makes progress partly by pretending that you can, so you create these model systems that you talk about, model plants and so on, that you can then pretend are all identical and treat them as if they're atoms. (LG090915-00:07:54)

What is interesting about this contribution is that it arises from a discussion of a particular term, 'agency' and suggests that there are similarities in its use in systems biology and the social sciences, but in doing so it also draws a distinction between the 'dynamic' orientation of biology and the 'reductionist' approach in physics and chemistry. The reconciliation here would seem to be one that Sokolova's respondents would not recognise, but this is not the point: what matters is the engagement at a conceptual level that underlies the distinction drawn in terms of differing approaches. This might be represented as an issue of 'agency', but the issue is not definitional, it is conceptual. As we saw in the initial meetings discussed in Chap. 5, challenges tended to be represented with reference to terminology, but the engagement and the disagreements centred on conceptual differences. One of the aims of the CS meeting was to understand the nature of 'security', but this served merely as a touchstone for exchanges engaging with theoretical, philosophical and methodological challenges. Similarly, the terms 'global connections' and 'material culture' featured in the chair's introduction to the discussion: 'first things first… it might be useful just to sort of lay out here clearly what we mean by those terms… then use the day to sharpen our ideas and to create some kind of shared ground where we all can more or less agree about some of those terms.' In fact, there was no explicit agreement but the terms served as valuable points of orientation in what was a successful exploration of common ground and shared understanding.

What this suggests is that academics use terms as points of reference, as indexical of more profound issues, and our data suggest that given the opportunity they will engage enthusiastically in discussions of theoretical and methodological differences. In the light of this, their comments about terminological differences may have been over-interpreted by researchers, who have then gone on to suggest that one of the keys to successful interdisciplinary collaboration is the resolution of these differences.

A final point that might be made about terminology is that in the area of applied linguistics concerned with understanding the nature of academic discourse, both written and spoken, it has long been known that sub-technical lexis represents a much greater obstacle to understanding than technical lexis (see, for example, Baker 1988). Words such as 'function', 'factor' or even 'effective' (in sociology positively loaded but in biology meaning simply 'having an effect') are likely to cause more problems than, for example, 'photopolymerization' or 'homozygous', simply because the latter stand out as needing to be explained to the non-specialist whereas shared meaning might be assumed in the case of the former and this can lead to misunderstanding. Nevertheless the resolution of such misunderstandings represents a relatively minor local problem set against the much more profound differences arising from conceptual assumptions. In any case, as the next chapter will show, there may be far more serious and hitherto undetected challenges to interdisciplinary engagement that require our attention.

References

Aijmer, K. (2013). *Understanding pragmatic markers: A variational pragmatic approach*. Edinburgh: Edinburgh University Press.

Amey, M. J., & Brown, D. F. (2005). Interdisciplinary collaboration and academic work: A case study of a university partnership. *New Directions for Teaching and Learning, 102*, 23–35.

Baker, M. (1988). Sub-technical vocabulary and the ESP teacher: An analysis of some rhetorical items in medical journal articles. *Reading in a Foreign Language, 4*(2), 91–105.

Blakemore, D. (1988). So as a constraint on relevance. In R. M. Kempson (Ed.), *Mental representations: The interface between language and reality* (pp. 183–195). Cambridge: Cambridge University Press.

Blakemore, D. (2004). Discourse markers. In L. R. Horn & G. Ward (Eds.), *The handbook of pragmatics* (pp. 222–240). Oxford: Blackwood.

Bolden, G. B. (2006). Little words that matter: Discourse markers 'so' and 'oh' and the doing of other-attentiveness in social interaction. *Journal of Communication, 56*, 661–688.

Bolden, G. B. (2008). 'So what's up?': Using the discourse marker *so* to launch conversational business. *Research on Language and Social Interaction, 41*(3), 302–337.

Bolden, G. B. (2009). Implementing incipient actions: The discourse marker 'so' in English conversation. *Journal of Pragmatics, 41*(5), 974–998.

Bryman, A. (2006). Paradigm peace and the implications for quality. *International Journal of Social Research Methodology, 9*(2), 111–126.

Buysse, L. (2012). *So* as a multifunctional discourse marker in native and learner speech. *Journal of Pragmatics, 44*(13), 1764–1782.

Creamer, E. G. (2005). Insight from multiple disciplinary angles: A case study of an interdisciplinary research team. *New Directions in Teaching and Learning, 102*, 37–44.

Díaz, F., Antaki, C., & Collins, A. F. (1996). Using completion to formulate a statement collectively. *Journal of Pragmatics, 26*(4), 525–542.

Donato, R. (2004). Aspects of collaboration in pedagogic discourse. *Annual Review of Applied Linguistics, 24*, 284–302.

Fischer, K. (2006). Towards an understanding of the spectrum of approaches to discourse particles: Introduction to the volume. In K. Fischer (Ed.), *Approaches to discourse particles* (pp. 1–20). Amsterdam: Elsevier.

Fraser, B. (1990). An approach to discourse markers. *Journal of Pragmatics, 14*(3), 383–395.

Fraser, B. (1999). What are discourse markers? *Journal of Pragmatics, 31*(7), 931–952.

Goodwin, M. H., & Goodwin, C. (1987). Children's arguing. In S. Philips, S. Steele, & C. Tanz (Eds.), *Language, gender, and sex in comparative perspective* (pp. 240–248). Cambridge: Cambridge University Press.

Gordon, C. (2003). Aligning as a team: Forms of conjoined participation in (stepfamily) interaction. *Research on Language and Social Interaction, 36*(4), 395–431.

Hamilton, A., Watson, F., Davies, A. L., & Hanley, N. (2009). Interdisciplinary conversations: The collective model. In S. Sörlin & P. Warde (Eds.), *Nature's end: History and the environment* (pp. 162–187). Basingstoke: Palgrave MacMillan.

Hansen, M.-B. M. (1997). Alors and donc in spoken French: A reanalysis. *Journal of Pragmatics, 28*(2), 153–187.

Heritage, J. (1984). A change-of-state token and aspects of its sequential placement. In J. M. Atkinson & J. Heritage (Eds.), *Structures of social action: Studies in conversation analysis* (pp. 299–345). Cambridge: Cambridge University Press.

Heritage, J. (2012a). Epistemics in action. Action formation and territories of knowledge. *Research on Language and Social Interaction, 45*(1), 1–29.

Heritage, J. (2012b). The epistemic engine: Sequence organization and territories of knowledge. *Research on Language and Social Interaction, 45*(1), 30–52.

Heritage, J. (2013). Turn-initial position and some of its occupants. *Journal of Pragmatics, 57*, 331–337.

Jefferson, G. (1987). On exposed and embedded correction in conversation. In G. Button & J. Lee (Eds.), *Talk and social organisation* (pp. 86–100). Clevedon: Multilingual Matters.

Jefferson, G. (1989). Preliminary notes on a possible metric which provides for a 'standard maximum' silence of approximately one second in conversation. In D. Roger & P. Bull (Eds.), *Conversation* (pp. 166–196). Clevedon: Multilingual Matters.

Johnson, A. (2002). So…?: Pragmatic implications of so-prefaced questions in formal police interviews. In J. Cotterill (Ed.), *Language in the legal process* (pp. 91–110). New York: Palgrave MacMillan.

Kangasharju, H. (1996). Aligning as a team in multiparty conversation. *Journal of Pragmatics, 26*(3), 291–319.

Koshik, I. (2002). Designedly incomplete utterances: A pedagogical practice for eliciting knowledge displays in error correction sequences. *Research on Language and Social Interaction, 35*(3), 277–309.

Lam, P. W. Y. (2009). The effect of text type on the use of so as a discourse particle. *Discourse Studies, 11*(3), 353–372.
Lam, P. W. Y. (2010). Toward a functional framework for discourse particles: A comparison of well and so. *Text & Talk, 30*(6), 657–675.
Lerner, G. H. (1996). On the 'semi-permeable' character of grammatical units in conversation: Conditional entry into the turn space of another speaker. In E. Ochs, E. A. Schegloff, & S. A. Thompson (Eds.), *Interaction and grammar* (pp. 238–276). Cambridge: Cambridge University Press.
Lerner, G. H. (2002). Turn-sharing: The choral co-production of talk-in-interaction. In C. E. Ford, B. A. Fox, & S. A. Thompson (Eds.), *The language of turn and sequence* (pp. 225–256). Oxford: Oxford University Press.
López-Yáñez, J., & Altopiedi, M. (2015). Evolution and social dynamics of acknowledged research groups. *Higher Education, 70*, 629–647.
Mercer, N. (2000). *Words and minds: How we use language to think together*. London: Routledge.
Redeker, G. (1990). Ideational and pragmatic markers of discourse structure. *Journal of Pragmatics, 14*(3), 367–381.
Redeker, G. (1991). Linguistic markers of discourse structure. *Linguistics, 29*, 1139–1172.
Sacks, H. (1992). In G. Jefferson (Ed.), *Lectures on conversation* (Vol. 1). Oxford: Blackwell.
Schegloff, E. A. (1980). Preliminaries to preliminaries: 'Can I ask you a question?'. *Sociological Inquiry, 50*, 104–152.
Schegloff, E. A. (1987). Recycled turn beginnings: A precise repair mechanism in conversation's turn-taking organization. In G. Button & J. R. E. Lee (Eds.), *Talk and social organization* (pp. 70–85). Clevedon: Multilingual Matters.
Schegloff, E. A. (2005). Presequences and indirection. Applying speech act theory to ordinary conversation. *Journal of Pragmatics, 12*(1), 55–62.
Schegloff, E., & Sacks, H. (1973). Opening up closings. *Semiotica, 7*(4), 289–327.
Schiffrin, D. (1987). *Discourse markers*. Cambridge: Cambridge University Press.
Sokolova, T. (2012). Achieving integration in interdisciplinary research: Strategy or emergence? A case study of interdisciplinary research in Sweden. Unpublished Masters thesis in Sustainable Development at Uppsala University, Nr. 109, 63pp., 30 ECTS/hp.
Tannen, D. (1989). *Talking voices: Repetition, dialogue, and imagery in conversational discourse*. Cambridge: Cambridge University Press.
van Rees, M. A. (1992). The adequacy of speech act theory for explaining conversational phenomena: A response to some conversation analytical critics. *Journal of Pragmatics, 17*(1), 31–47.

7

Disciplinary Identity

Identity Work

Current views of identity see it as something fluid and complex, irreducible to a particular set of categories or an overarching label. Such characterisations might be descriptively convenient but they are ontologically incomplete, and effective analysis calls for sensitivity to the ways in which different identities are presented, constructed, exploited or otherwise made relevant. Although identities might be socially, culturally and interpersonally constructed, they are also open to challenge and ultimately, as Lawler (2014: 2) notes, '*all* identity-making is an accomplishment.' While context has an important bearing on identity work, it is important not to allow this to influence analysis because, as Schegloff (1987: 219) has persuasively demonstrated, local contingencies can produce sudden and radical shifts in the identities to which participants orient. He gives the example of a doctor-patient encounter in a consulting room during which the doctor accidently knocks over a glass of water, at which point the nature of the interaction changes as the professional identity is set aside and the doctor becomes 'the one who just tipped over the glass of water on the table'.

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Identity is a heavily theorised concept, and while analysis that follows adopts the perspective just outlined it does not adhere to any of the many theories that are available—which is not to say that aspects of our analysis might not be explicable in terms of these. The ways in which the systems biologists in our study position themselves with respect to the academy and the dynamic interplay of 'wet' and 'dry' perspectives, for example, suggest that the ingroup/outgroup relationship at the heart of social identity theory (Tajfel 1982) would offer explanatory purchase. Our interest, however, is in the implications of identity behaviour for interdisciplinary research rather than in the nature of identity as such. Our focus in what follows is therefore on the notion of identity work proposed by Tracy and Naughton (2000: 74), which 'refers to the way talk implicates self, partners' identities and, where relevant, the institutional group identity or that of non-present others'. We begin with a very brief illustration of some of the ways in which such identities are made relevant in talk before moving on to an examination of aspects of identity within systems biology, following Benwell and Stokoe (2006) in focusing on a specific discursive environment within which identity work gets done.

Sometimes a single work or action is adequate to represent a specific identity. Initial meetings of all sorts, for example, typically begin with identity statements that allow other participants to situate themselves with respect to others present. In initial research meetings such statements are often framed in terms of the speaker's expertise, normally beginning with a name, possibly with a formal title or post held, and academic affiliation followed by a description of research interests:

> I'm Sarah Main from the Asian Department of the M of N. I'm primarily a Mughal specialist dealing with the late 16th century, early 17th century, and particularly with the relations with the local court rather than with Europe. (HI110413-00:06:40)

At the other extreme, identities may be constructed by others and never made explicit. In Extract 7.1 Paul has been leading the meeting in place of Carl, who is the senior academic in the group. Carl appears half way through the meeting, and following an initial exchange of meetings leadership is transferred to him.

Extract 7.1

01 Paul: Just in the middle of eh we just discussed micro TSAs that we
02 might test against
03 Carl: uHUH!
04 Paul: and erm Louise is just going to show her recent QPCR data
05 Carl: Okay.
06 Paul: if you would like to join in
07 Carl: Yup!
08 Paul: Ehm let me introduce you to Sun Tsu.
09 Carl: Hi!
(WSBNF0310-00:33:41)

The most obvious feature of the exchange is that it involves Paul and Carl and that Carl's responses are minimal. Paul interrupts the meeting in order to explain what has just been discussed and what is about to happen, then formally introduces Sun Tsu, who has joined the meeting for the first time. He also invites Carl to join in. It would not be unusual for a new arrival to be informed of the business in hand, but an invitation to join in and a formal introduction would be most unusual, as would an extended exchange between the person leading the meeting and the new arrival, which is what follows in the extract. In fact, at one point in the exchange the focus shifts away from the meeting itself to what is essentially a private exchange between Paul and Carl during which Paul reports on a meeting with a colleague from another university.

There are various other ways in which Carl demonstrates his leadership in the remainder of the meeting, as in proposing actions ('so I think once once you've done that there will be lots of other things we can do' – 02:01:54) or pinning down key questions: 'that's the question isn't it does it erm down regulate genes or up regulate genes when it's on you know ((cough)) erm (22.0) I guess it would really be nice to know what physiological TNF alpha erm you know activation really is' (01:28:44). More interestingly in the light of the analysis of 'so' developed in Chap. 6, from the time of his arrival he is almost the only speaker who uses so-prefaced turns. The other participants use only four such turns in all, while Carl uses 26 a number of which involve leadership behaviour.

More typically, identity is implicated in epistemic rights, as when Kate's explanation to Paul about what happens in experiments identifies her as a biologist (a 'wet') and Paul as a non-biologist (a 'dry') who does not get directly involved in experiments:

> Biochemical experiments things go wrong. You know you don't ((inhales and exhales loudly)) Like DKR reactions fail, chip reactions fail you know you don't always get a clear result. And so sometimes you've got to do it several times before you get a clear picture. (Kate, WSBLH0513-00:20:35)

In what follows we focus on aspects of identity in the context of systems biology where the relationship between wets and dries is not only fundamental to successful project outcomes but also demands very careful negotiation that is not always forthcoming. First, though, we set the disciplinary context within which these identities are constructed and deployed.

The Identity of the Group: Systems Biology

Systems biology is a relatively new field within biology that studies the nature of biological systems, seeking to understand their structures and dynamic behaviours within these, focusing particularly on genes and their associated metabolism networks. Because this involves comprehensive quantitative analysis of the ways in which components in the system interact over time, it requires the development and use of sophisticated technological and computational tools for which the field needs to draw on a wide range of expertise. In addition to biologists, therefore, research in systems biology may involve mathematicians, statisticians, computer scientists, bioinformaticians, engineers and physicists, making the enterprise inherently interdisciplinary.

Although a relatively new field, systems biology is already sufficiently well established for members from the disciplines involved to define themselves as systems biologists, though it is by no means established as a discipline in itself. In fact, in the view of Calvert and Fujimura (2011: 156), '[w]hether systems biology will become a discipline—and if it does, what kind of discipline it will become—remains to be seen.' The authors draw attention to the importance of its social and organisational aspects noting that some of the interviewees in their study seemed to regard it as 'some kind of sociological experiment' (ibid.). It is certainly at an interesting stage in its development and is capable of stirring both excitement and doubt, sometimes in the same breath: 'the success of systems biology', argues Kirschner (2005: 504), 'is essential if we are to understand life; its success is far from assured.' This uncertainty and its status as an interdiscipline make it an interesting site for study from the perspective of how different identities are managed. This section focusses on the discipline as a whole and its response to external perceptions of itself, while the next will move to identities within the discipline as a prelude to considering problems arising from these.

While there may be 'no single concise definition of systems biology' (Katze 2013: v), the term has general currency within the academic community and, as Extract 6.9 showed, is accepted by mainstream biologists as part of their wider discipline. Its academic identity is therefore treated as a given within systems biology, as when Amy refers to 'the rest of the systems biology community' and in using 'the rest' claims membership for herself. The intellectual self-confidence that Kogan (2000: 29) sees as fundamental to the academic development of a discipline is evident in the exchanges in our data, though the problems associated with the externally perceived status of an interdiscipline seem to be recognised and are well known within systems biology (see Agrawal 1999 and Calvert and Fujimura 2011 for examples of resistance by defenders of the status quo). These are most pressing in matters of securing funding, where systems biology is regarded by some as an artificial construct lacking disciplinary substance. In fact, Katze (2013: vii) has gone so far as to claim that 'everyone engaged in systems biology research has heard the criticism that the approach is nothing more than an expensive fishing expedition that takes funding away from individual investigators.'

Criticisms of this sort call into question claims to disciplinary status by denying the legitimacy of identity claims based on academic content and proposing instead a form of pragmatic association. Myers (1990: 60) has argued that the 'proposal process…changes the field in a more fundamental way, by challenging the terms in which the subspeciality defines itself' and nowhere is the existential challenge to systems biology more acute than in the implicit rejection by funding bodies of its interdisciplinary status. The data includes examples of at least two ways in which this rejection is manifested, the first in a requirement that systems biology conform to the disciplinary norm of representability by a member with a general grasp of the relevant field and the second in a perceived rejection of the disciplinary categorisation that situates the group within the academy. Extracts 7.2 and 7.3 provide examples of the group's response to these, and at this point it is worth noting that although our data is drawn from the United Kingdom similar problems are reported in the United States, where the relevant sections of the National Institutes of Health in the United States 'are relatively conservative in funding what they consider to be risky projects and new approaches' (Aderem 2005: 512).

Project teams may be expected to present regular reports to the relevant grant awarding body, and in Extract 7.2 Carl describes what happened when Julia, a biologist, was asked to represent her fellow systems biologists to a panel assessing the progress of their project.

Extract 7.2

> When Julia made <u>her</u> presentation I left the <u>room</u> and then the committee asked me to come back <u>in</u> and sit there but I was told I had to be silent and it was a big <u>mistake</u> because you know they were asking Julia questions about the <u>theory</u> and I had to just sit there so you know it was stupid so <u>Jim</u> has suggested to me that I should go <u>with</u> him when he does the presentation but it would look crazy if you know I go so I don't quite know what the situation what the best thing to do is. (WSBPR0428/2-01:38:27)

Although Carl is allowed to be present in the room, his identity is that of spectator and not participant. Julia is treated by the panel as though she is representing a single-discipline project and is therefore sufficiently familiar with the relevant knowledge domain to answer questions on the project as a whole. The fact that the project depends on the engagement of specialists from different disciplines and Julia's expertise does not extend to 'dry' aspects is not treated as a relevant consideration and

Carl, who is in a position to offer a 'dry' perspective, is excluded. In insisting that Julia perform an identity beyond the limits of her epistemic competence, the panel are implicitly rejecting the legitimacy of the claim of systems biology to disciplinary coherence, a position that Carl dismisses as 'stupid'.

In a different meeting, also involving Carl, the discussion has centred on arrangements for a bid related to ageing and health, and at the conclusion of the topic John draws attention to a change in the name of the category under which the bid will be submitted. What follows from this is represented in Extract 7.3.

Extract 7.3

John:	You don't call it systems biology any
	mo[re you call it new ways of] working.
Carl:	[New ways of work. Yeah]
John:	Yeah kh!hah[ahah
Paul:	[Or new directions [because] it's=
John:	[Is that r]ight.
Paul:	=use[ful.
John:	[I'll have to- we'll have to remember that.
Paul:	(xxx [xxxx.)
Carl:	[Well actually in this studentship,]
John:	[It is new ways of working panel] I think.
Carl:	In their st[udent]ship it's the same they've gone=
Paul:	[Yeah?]
Carl:	=even further back that they now say they wa-
	it just says that we want mathematical and
	computation[al
John:	[I thought that was bizarre.
Carl:	Heheheh
John:	Absolutely.
Carl:	Yeah …
John:	Absolutely
Carl:	Yeah
John:	I was stunned by that. It's absolutely bizarre.
Carl:	W- yeah [doesn't] mention systems biology just say they=
John:	[Bizarre]

26 Carl: =want mathematical and computational.
27 John: Yeah
28 Carl: Yeah
29 Ben: Yeah
(WSBCH0415-02:06:35)

The exchange in Extract 7.3 falls roughly into two parts: a discussion of a change in the name of a funding panel (ll.1–11) followed by an assessment of one of the consequences of this. Associated with the panel's name change is a requirement that applicants for a studentship should have a mathematical or computational background, thus excluding those with biological expertise and thereby restricting the field to only half of the potential pool. Carl's summary of the situation is immediately followed in line 17 by what Fasulo and Zucchermaglio (2002) describe as an 'epistemic IMU [I-Marked Utterance]', a mitigation device allowing the alignment of speaker and listeners with respect to the claim. Carl's supportive laughter prompts an immediate upgrading by John ('absolutely'), repeated in a sequence that leads to further upgrading ('I was stunned by that'), each turn receiving positive feedback from Carl. Pomerantz (1984) has shown how the incremental design of assessments allows participants to collectively establish shared perspectives and orientations, and the sequence concludes with a comment from Carl on the erasure of 'systems biology' that links back to John's opening observation and elicits assent from participants.

In this exchange we see team members orient to a threat to their academic identity as systems biologists. Their almost resigned acceptance of the recategorisation of their activity by funding bodies might be explained by the fact that the new title applies to the panels and not to them directly, but where its consequences impact on their work they resist the withholding of the membership category 'systems biologist' from new entrants to their community by representing it as 'absolutely bizarre'. The shift is marked by a move from the use of 'you' in the first part, reflecting an acceptance of the new status quo without reference to the panel, to a 'they' orientation at the start of the second part (l.12), thus implicating the panel in the decision and thereby establishing them as a legitimate target for criticism. In co-constructing a response to this, the group reveal a tacit notion of the essence of their own discipline (Gerholm 1990: 265–66) and at the same time implicitly affirm their shared identity as systems biologists, transcending the division between 'wets' and 'dries' that characterises the interdiscipline. In the remainder of this chapter we explore how these two very different identities are negotiated in project meetings.

Identities Within the Group: Wets and Dries

Although systems biology draws on a wide range of disciplines in order to achieve its research goals, there is a fundamental division in the discipline between those who conduct experiments and those who focus on analysing the data produced by the experiments. The former are biologists working in a laboratory and are known as 'wets', whereas the mathematicians, statisticians and so on sitting at a desk in front of a computer screen are referred to as 'dries'. Ultimately, the success of systems biology depends on the successful interaction of these two groups, and it would not be an exaggeration to say that the differences between them inform nearly all aspects of their engagements. All participants have a degree of understanding of the work undertaken by their colleagues from the other group and in some cases this understanding is extensive, but the areas of expertise involved are very different.

The limits this places on understanding are sometimes explicit, as when Alex admits to being 'fuzzy on the biological interpretation myself…' (WSBRE0310-00:59:04), and where such recognition is not forthcoming, participants may take it upon themselves to assert their epistemic rights to judgement. Jane provides perhaps the most explicit example of this in our data when she supports her claim with a hyperbolic appeal to her extensive biological experience: 'I've been staring at these genes for all my life okay. So I can tell you whether you whether if you come up with a certain pattern whether that makes any sense biological sense or not' (WSBID0308-00:50:28).

The distinction also permeates procedural decisions in various ways. It emerges, for example, in discussions about possible papers, in terms of both content and authorship. Dave's 'But do you need erm erm wet insight well you know biological insight into that' (WSBPR0428/1-00:04:30) is an example of the former, while the exchange between Joan and Doug on the subject of a suggested inclusion captures the dilemma of a potentially diverse readership: Doug takes up Joan's 'I mean certainly if a biologist reads it they won't even think about it. But if a statistician reads it' with 'If a statistician reads it they'll tell you it's wrong to the analysis (and xxxxx) theory' (WSBPR0526/5-00:27:56).

The challenges of appealing to both groups are also confronted when the team are discussing a forthcoming interview that a junior colleague is facing. He is a dry and they have set up a mock interview with another dry who will 'beat him up', but he will also need to prepare for questions from a biologist and Mark appeals to Carl to 'find a sort of random if there is a random biologist who would be willing to talk to him at the same time then that would be very good' (WSBNF0415-01:19:41). Fortunately, Carl is able to suggest someone. The distinction also needs to be borne in mind in plans and arrangements related to projects themselves. In Extract 7.4, for example, Paul justifies his objection to having wets and dries finish at the same time by implying that if wets are involved in the final stages, progress on the analysis will be inhibited, prompting Mark to justify the decision because of the need for 'testing out' biological concepts in the light of the data.

Extract 7.4

Paul: I'm not sure it makes sense to have the post docs wet and dry
end at the same point because the last stage at the end of the
produce would never be analysed.
Mark: I'm not sure Paul I'll tell you why because there's going to be
some follow up stuff in testing out conc- biological concepts
generated in data.
(WSBCH0415-02:07:57)

It would be misleading, however, to give the impression that the distinction between wets and dries is something that represents a challenge that needs to be addressed; it also provides a rich resource for joking and teasing amongst the team members, as Extract 7.5 illustrates.

Extract 7.5

01	Carl:	So unless one could come up with a good reason for doing the
02		BCD I would have thought you would do input instead
03	Emma:	Mmm
04	Paul:	It could just be well it is quite easy the BCD
05		(6.0)
06	Roy:	Okay another option or suggestion
07	Carl:	That's if Paul does the experiment is it
08		((General laughter))
09	Paul:	That would be the safe option.
10	Roy:	A:::h,
11		(3.0)
12	Mark:	Well Ivan's an experimentalist now so he
13	Carl:	Oh is he has he been trained up?
14	Mark:	Ivan has been seen repeatedly walking around with … gloves on
15	Emma:	Mmm.
16	Paul:	Oh [my god.]
17	Mark:	[(In his xx]xx. Really.) Honestly it's qui- it's a remarkable
18	Carl:	But has he actually been seen using them for
19		anything [significant ((laughs))
20	Mark:	[Yeah! Just (well he xxxxx xxx). He's really quite
21		(2.0)
22	Paul:	I'll keep an eye on him.
23	Carl:	((Laughs))
24	Emma:	Heh!
25		(10.0)
26	Carl:	Maybe he'll go native.
		(WSBNF0415/2-00:46:35)

The humour here arises from Paul's claim that doing the BCD is 'quite easy' and begins when Roy has called for another option. Although Carl's turn follows this and a six-second silence, it is clearly designed to respond to Paul's earlier comment, asking whether BCD is easy because Paul is doing the experiment and prompting laughter because Paul is a dry and therefore without experience in conducting experiments. Paul's riposte (l.9) that it would be a 'safe option' amounts to an implicit claim that dries are more reliable than wets, and Mark picks up the theme of dries moving into wets' territory by referring to the fact that Ivan, a dry, has become involved in experimentation, as evidenced by the fact that he has been seen 'repeatedly walking round with gloves on'—something no dry would need to do. This sets up the humorous reactions that follow, all playing off the idea of an unbridgeable gulf between wets and dries.

Despite its manifestation across different dimensions, an interesting aspect of the wet/dry division is that there is no evidence of any terminological problems, though as in many professional contexts jargon is to be avoided. When Lucy, a wet, explains that 'in terms of the D-E-Fs I was gonna do an E-C-D, but then I think I could do an E-C-D on the 3C thing', Carl, a dry, comments 'No jargon there, then' (WSBPR0428/2-01:27:05) eliciting general laughter at her expense. As this and the other extracts in this section have demonstrated, the wet/dry division is treated by systems biologists not only as a matter of practical relevance but also as a resource for humour, usually in the form of gentle teasing. There is no evidence that those involved regard the relationship in anything other than positive terms, but a closer look at their interaction reveals an epistemic asymmetry that has the potential to undermine effective collaboration. It arises from an assumption that has been noticed by Calvert and Fujimura (2011: 161):

> It should also be noted that although there is an emphasis on computational modelling in systems biology, most systems biologists think there is still an essential role for 'wet' experiments, carried out at the laboratory bench rather than on a computer.

This emphasis emerged, for example, in a meeting where the team were discussing a potential paper arising from their research taking the form of comments about the need to emphasise biological aspects of the paper:

> We can get <u>more</u> out of it. More biological insight into it.' (Dave, WSBPR0428/1-00:07:58)

> 'The more biological <u>relevance</u> you have the stronger your paper will be or the <u>more</u> people will read it. (Carl, WSBPR0428/1-00:09:38)

Although these suggestions come from the leading figures in the team, Dave being the principal investigator and Carly the senior academic, they are explicitly presented to the group and open to challenge or further discussion. However, there is a more subtle asymmetry in play that is detectable only through close analysis of the interaction and the next section will focus on this.

Identity and Epistemic Asymmetry

'Discursive practices', argues Creamer (2005: 41), 'help collaborators move beyond an individualistic or disciplinary stance to one that integrates knowledge from different domains.' The evidence from our data overwhelmingly supports this claim and the general recognition of the importance of collaborative interaction. However, in this concluding section we show that even within an overtly collaborative orientation identity differences may be responsible for fault lines that threaten productive engagement—that the division between wet and dry may not always be as balanced as might be expected.

While in Morrison et al.'s terms (2003: 293) the projects we studied involved *vertical* teams in which junior staff collaborated with professors, academic status was actually less salient than epistemic status, and it is here that clear asymmetries could be found, with potentially damaging consequences for the successful development of interdisciplinary projects. An impression of the imbalance can be gained from the uneven levels of participation of the wets and dries of the five LH research group meetings represented in Fig. 7.1. Each of the meetings typically lasted two hours and involved six participants, though not all members were present in some meetings, as missing bars indicate. The y-axis represents each member's turns as a proportion of the total number of turns in each meeting.

While analyses of this sort are merely indicative, they nevertheless provide a useful overview that may or may not lend weight to the evidence of close analysis and where very clear patterns emerge, as here, they are worth noting. For with the exception of Anne, a dry team member who most closely interacts with both the wet team and dry team, the level of participation between the dries and wets is clearly different. In fact, Anne's contributions are greater than those of any other member except in the two meetings where Carl, also

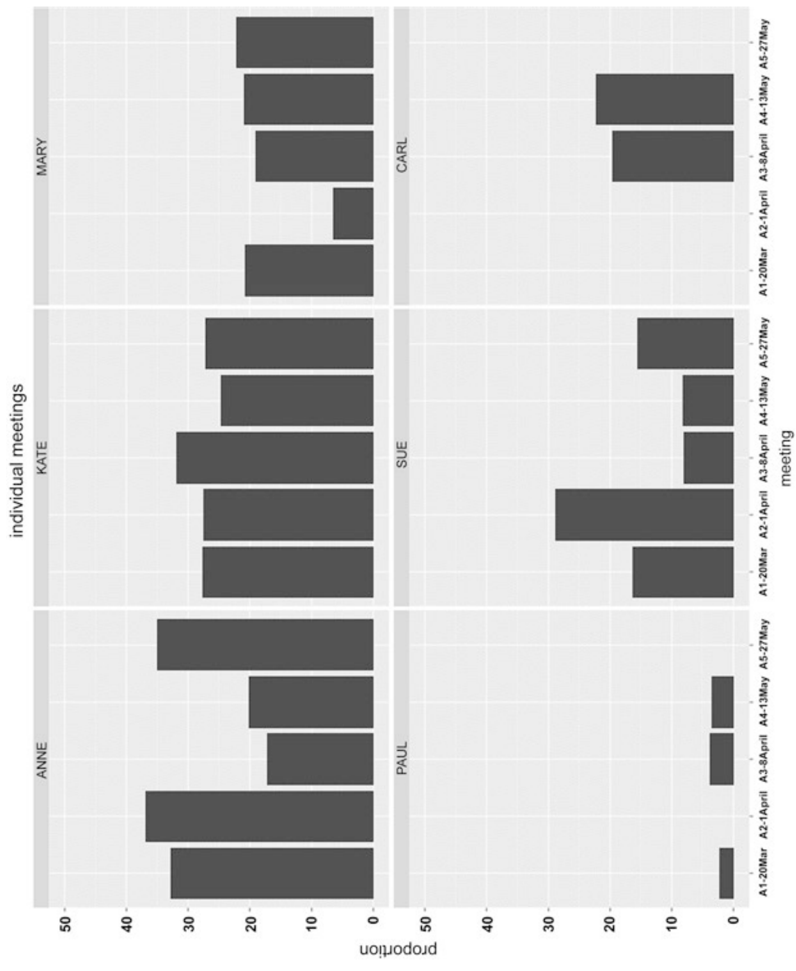

Fig. 7.1 Members' individual participation in five meetings

a mathematician and the senior figure in the group, is present. The difference in participation is most clearly exemplified in a comparison of Kate and Mary (wets) with Sue and Paul (dries). Apart from in one meeting which exceptionally featured a dry topic (and where Mary's contribution was therefore unusually low), Sue's level of participation was consistently below that of the wets, while Paul's was minimal in all the meetings he attended.

In order to provide more detailed explication of how the imbalance suggested here played out in practice, we examine a single passage of talk (Extracts 7.6(1)–(4)) illustrating how displays of knowledge are managed as part of the process of building shared understanding and how disciplinary identities are associated with epistemic rights. Of particular interest in this passage is the different ways in which claims by Kate (a wet) and Sue (a dry) are handled and the implications of this for the groups they each represent.

Interdisciplinary projects involve the encounter of different epistemic domains (Stivers and Rossano 2010), exposing differences in understanding, and the passage will reveal how Sue's pursuit of a line of questioning is closed down by an implicit rejection of her rights, as a dry, to relevant knowledge.

The exchanges occur once the business of the meeting has been under way for nearly ten minutes. Mary has been explaining how the experiment is progressing, and there has been a brief discussion (drawing on this and the visual display that accompanied her account) of how a transgene features. Extract 7.6(1) begins as she explains one of the things that the experimenters have noticed.

Extract 7.6(1)

```
01   Mary: …And so:::
02         (1.0)
03   Mary: We're see:ing
04         (1.2)
05   Mary: less of a trans gene coming down if you
06         c'n mutate the five m-ay motifs,
07         (0.8)
08   Kate: °mhm°=
09   Mary: and less:
10         (0.4)
11   Mary: of the trans gene coming down if we (.)
```

```
       mutate the gee box as well.
       (0.6)
Kate:  So this is just mutating the five ay
       motifs which are on the side of the gee
       box.
Mary:  ↓Yeh.
       (0.8)
Kate:  's not mutating all of them.
Mary:  ↓No.
       (0.6)
Mary:  [[Get  just  tho:se.]
Kate:  [[You'll get- you'll] get a hundred per
       cent reduction
       (0.5)
Kate:  Yea:h?=
Mary:  =Ehrr(x)e-
       (1.5)
Mary:  e(x) °mm°
Kate?: Kh!hehheh! ·hhh=
       (WSBLH0513-00:10:43)
```

Mary's explanation (ll.1–12) begins with a noticeably stretched 'so:::' and is marked by noticeable pauses. Kate's quiet continuer (Schegloff 1982) following the first of Mary's two points (l.8) indicates that she is following them, and it is she who produces (ll.14–16) an example of what Heritage (2012: 36) has described as 'inference marked declarative utterances that address knowledge or information that is properly in the recipient's epistemic domain' (Heritage 2012: 36). Mary's rights to this knowledge are clearly displayed in her very definite polar responses to both this and Kate's subsequent associated claim (ll.17 and 20) and her representation of the understanding Kate has just displayed. The development of the talk at this point serves to make clear the status of the inference in the context of building understanding amongst the group. There seems to be a clear difference between an inference that serves merely to establish that the speaker has understood the point under consideration and one that serves as a preface to contribution with potential epistemic purchase (as in the case of the so-sequences discussed in the last chapter). Extract 7.7 provides an example of the former.

Extract 7.7

```
Carl:  Oh this is act'y in: binding to em: (.)
       this pro↑moter:=
Kate:  =No this is PK binding (.) to the
       acting promote:r
Anne:  So 'shouldn't bind=
Carl:  =PK  ┌binding  to the a┐ct-=
Mary:       └it shouldn't bind┘
Anne:  =°Oh°=
Carl:  = O:h ri┌ght (.) °yeah°      ┐
Mary:          └So you get so       ┘me background
       fragments
       (WSBLH0513-00:25:43)
```

Kate has just corrected Carl's understanding of the nature of the binding, at which point (l.5) Anne produces an inference from this that receives confirmation from Mary in the form of a reiteration, overlapping Carl's latched turn. The change-of-state tokens (Heritage 1984) that follow from both Anne and Carl mark the receipt of this confirmation, and Mary proceeds to describe a consequence of it for outcomes of the experiment and further elaborations follow. The format of sequences such as this is broadly that of an adjacency pair (inference followed by confirmation/correction) with an optional third element marking receipt of the second pair part. The format in Extract 7.6, however, is different. Kate's 'so'-prefaced inference in line 14 serves as a preface to a claim about the implications of this (l.23).

The distinction between what might be described as so-prefaced inferential checks and inferential prefaces has epistemic relevance to the work being done through the talk. In the case of the former, two- or three-part sequences, epistemic rights remain entirely with the recipient to whom the inference is directed, whereas inferential prefaces are the beginnings of longer sequences in which the speaker will claim epistemic rights. The ways in which such claims are received are determined at least to some extent by territorial entitlements and as Extract 7.6(2) shows, Kate's claim is not accepted.

Extract 7.6(2)

```
23  Kate:  You'll get- you'll get a hundred per
24         cent reduction
25         (0.5)
26  Kate:  Yea:h?=
27  Mary:  =Ehrr(x)e-
28         (1.5)
29  Mary:  e-(x) °mm°
30  Kate:  Kh!hehheh! ·hhhh=
31  Anne:  =Just=
32  Paul:  =(x┌xx xxxxx)
33  Anne:     └so. So 're we try:ing mutating yet?
34  Mary:  So: It's e:::r either ┌two:: (xxxxxxx)=
35  Kate:                        └O(.)kay those=
36  Mary:  =you   (xxxxx┐ise)
37  Kate:  =thos:e okay.┘
38         (0.3)
39  Mary:  on ┌the gee box.
40  Anne:     └On either side of the:: new element
41         and the gee ↓box.
42  Mary:  (Yeah a xx)
43  Anne:  Is there a new element (.) not on- (.)
44         (a xxx xx xxx xxx)
           (WSBLH0513-00:11:02)
```

Epistemic claims such as this are consequential for the shared understanding upon which subsequent talk will be founded and therefore predict a response that either validates or challenges them. When such a response is not immediately forthcoming (l.25), Kate invites a response from Mary before a 'standard maximum silence' (Jefferson 1989) has elapsed. This is met by a hesitation marker ('Ehrr(x)e-') and a much longer silence, itself followed by what sounds like the beginning of a response, immediately truncated with a 'catch' in the throat and followed by a muted minimal response (l.29). While preferred responses are delivered immediately and in an unmarked form, dispreferred responses are marked by pauses, hesitations, fillers, accounts, and so on (e.g. Pomerantz 1984), and this is how Kate appears to read Mary's responses, producing a sudden and brief burst of laughter that does not attract any shared laughter and is followed by a longish intake of breath (l.30). Two new speakers then immediately join the discussion, shifting the focus to another aspect of the experiment. Once Mary has directed attention to the relevant elements, Kate is quick to seize on the shift and mark her orientation to it (ll.35 and 37) as the talk progresses.

The membership categories and associated epistemic rights reflected in this extract are relevant to the way in which the talk is designed. While Heritage (2012: 33) has cautioned against assuming congruence between epistemic status and epistemic stance, in this case the relationship seems unproblematic. Like Mary, Kate is a biologist, and as project leader her status is higher than that of Mary, who is a post-doc student. Mary's epistemic rights derive from her closer association with the minutiae of the experiment and its current status, but Kate has stronger claims to matters of interpretation. In this case, however, it would appear that her claim does not hold water and rather than challenge this directly Mary opts for a strategy that involves marking any forthcoming response as dispreferred, leaving Kate to assess the legitimacy of her claim for herself. Kate's response in line 30 does this emphatically though indirectly.

The immediate shift that follows (ll.32–33) is interesting because it is jointly initiated by the two mathematicians in the group, thus not only moving the talk away from the point that Kate has raised but shifting its disciplinary locus and allowing Kate the opportunity to mark her understanding of a new aspect of the data.

The response to Kate's 'so'-prefaced inference is very different from the way Sue's contribution—superficially similar—is treated in Extract 7.6(3).

Extract 7.6(3)

```
  Sue:  Why are the blue ones not (.) the sa:me
        across
        (2.0)
  Sue:  across the experiment.
 Mary:  eh just because of the variability of
        the ↓chip.
        (1.5)
```

```
52   Mary:  'cuz: as much as I trie::d (.) like y'r
53          gonna have a biological effect 'cuz each
54          sample's different.
55    Sue:  Oka:y.
56   Mary:  So=
57    Sue:  =So ┌so if the- if THEIR if their┐=
58   Mary:      └I don't think there's e- o- ┘
59    Sue:  =variability wasn't there (.) you would
60          have
61          (0.4)
62    Sue:  they- they'd be all the same.
63          (0.8)
64  Kate?:  °HHehuh°
65   Mary:  I mea:n: w' ┌try an'┐ get them as:=
66  Kate?:              └Heheh! ┘
67   Mary:  =as (.) They're not that bad. Heh!hehheh!
68    ???:  ((Very short guttural sound.))
69   Mary:  I've had them worse than ┌that.
70    Sue:                           └No I w's jus-
71          trying to understand.
            (WSBLH0513-00:11:20)
```

Anne's question at the end of Extract 7.6(2) never receives an answer as Sue, who has not participated in the discussion up to this point addresses a question to Mary. Mary explains that the differences in 'the blue ones' arises from variability in the chip (ll.49–50), but when this is neither acknowledged nor followed up by Sue, she goes on to provide an explanation for it (ll.52–54). Mary's inclusion of a reference to a 'biological effect' in this explanation stands out prominently in a context where disciplinary associations are understood but very rarely made explicit in the talk and represent a claim to 'epistemic primacy' (Stivers et al. 2011: 13). There are only three other uses of 'biological' in the meeting, and these are necessary elements in technical expressions. Here, however, the reference is more general; it is a standard expectation in a biological experiment (something 'y'r gonna have'), deriving from inherent differences in the samples. Hence, Mary's failure to deliver uniform 'blue ones' is the result of biological conditions rather than inadequate efforts on her part. Directed at Sue, who is a statistician with relatively little experience of working with 'wets' like Mary, this represents a clear disciplinary claim to the relevant epistemic territory, which includes the right to bring this particular point to a close.

This seems to be accepted by Sue (l.55), and Mary begins a new turn apparently designed to represent her own understanding of some aspect of the findings. However, Sue's so-prefaced latched turn (l.57) reclaims the floor, using loudness and repetition to hold it against Mary's attempt to pursue her point. Sue's turn is hearable as a suggestion. The laughter it elicits may have arisen because the representation Sue proposes is a resolutely 'dry' reconfiguration that has no relevance to the realities of biological experimentation. In then locating the results within the broader context of experimental outcomes, against which they stack up reasonably well (ll.65–69), Mary positions Sue as a dry with no access to the relevant domain of knowledge. Sue implicitly accepts this ascription by making explicit the intended pragmatic force of her claim (Thomas 1984) as an attempt to understand (by someone not familiar with laboratory work) rather than a suggestion (from a biologist), hence conceding epistemic rights to Mary. In Extract 7.6(4), however, Sue again returns to the issue of variation.

Extract 7.6(4)

```
Mary:  Yeah. Yeah yeah. The blue ones ideally
       would be all the same.
       (0.5)
 Sue:  Mm.
       (0.8)
Mary:  But what we're really looking at (.) is
       the:: ratio of blue to [red.
 Sue:                         [So doesn't that
       mean you have quite a bit of variation
       and the red ones:
       (1.2)
 Sue:  in that kind of variation
       (0.4)
 Sue:  the red ones 're different in that kind
       of
       (1.8)
 Sue:  variation as we:ll
       (0.6)
 Sue:  isn'it.
```

```
Kate:  ·hhh maybe: if you want to really a-
       avoid this >kind've question< y' c'n
       express everything as a percent of the
       control.
       (1.0)
Mary:  ↓Yeh.
       (WSBLH0513-00:11:46)
```

Following her concessionary agreement and recognition that 'ideally' (i.e. far from the realities of biological experimentation) the blue ones would be the same, Mary shifts attention to the red ones, prompting yet another inference from Sue. Sue's question (ll.79–81) does not receive the predicted response, so she extends it and reformats it as a grammatically incongruous tag question (l.90) inviting a yes/no answer. Her extended reformulation includes a number of unfilled pauses but prompts an immediate response from Kate, who instead of responding to the question itself addresses the *category* of the question and suggests a way of avoiding questions falling under it. As Lindström and Mondada (2009: 304) note, '[i]n work settings, the rights to assess, as well as the epistemic authority of the assessors, are often related to professional expertise and to institutional membership categories', and the force of Kate's rights to assess the relevance of Sue's contribution are associated with her identity as leader of the project. Her comments are emphatically endorsed by Mary, and by the end of the exchange not only have Sue's questions not been answered, they have been seen as occasioned by an inappropriate representation of the data and thereby categorised as irrelevant to the main business in hand.

Mary's implicit assignment of the membership category (Sacks 1992) 'dry' to Sue in order to undermine the epistemic legitimacy of the latter's claims is achieved by invoking details of experimental procedure that fall outside her epistemic domain. This is a feature of wet-dry interaction that is fairly general, as one further example will illustrate. In Extract 7.8, Paul has been pursuing a line of argument which leads to the identification of a problem arising from differences in the data between different transgenic lines. Kate's response, supported by Mary, is again an appeal to experimental conditions, and although Paul subsequently pursues his argument it is to no avail in the face of practical contingencies to which he has no direct access.

Extract 7.8

```
Paul:  =yeah but if you had differences
       between the different transgenic
       li:nes (.) then
       (3.0)
Paul:  isn't there a problem of just
       having just one soft type line.
Kate:  But y'know how it is with: (.) you
       kno:w: (0.3) a (x)biochem- (.)
       you kno:w (0.5) biochemical
       experiments things go ↓wro::ng
       y[ou  kn]ow you don'-=
Mary:   [°yeah°]
Kate:  •hhh HHHhhh! >like< DKR reactions
       FAI:l, chip reactions fai:l you
       know you don't always get a clear
       result. (.) and so sometimes you
       got >to do it< several times
       before you get a clear picture.
Mary:  °mm°
       (WSBLH0513-00:20:26)
```

Exchanges of this sort are to be found across the LH dataset and find their most extreme form when Kate dismisses a series of suggestions from Sue by saying, ‘It's nothing to do with biology’ (WSBLH0401–01:31:33). Even though Sue is a statistician, both work in systems biology, so by claiming epistemic rights to determine what counts as ‘biology’ Kate is implicitly claiming priority for her own field. The implications of this can be properly understood in the context of Jovchelovitch's (2007: 138) concept of ‘intersubjective space of communication’:

> …encounters between knowledge systems depend on how different knowledges communicate and to what extent the constitution of an intersubjective space of communication allows for recognition or denial of the perspective expressed in the knowledge of the other.

The colonisation of this space by referencing experimental procedure or appropriating indexicals such as 'biology' establishes a pattern of epistemic precedence that threatens to undermine the balance that has been thus far regarded as characteristic of the collaborative orientation of interdisciplinary research projects.

Conclusion

This chapter has indicated some of the ways in which identity is displayed in interdisciplinary meetings but has focused particularly on research meetings in one interdiscipline in order to expose epistemic imbalances within it. The findings challenge the assumption that power differences can be neutralised by ensuring that representatives of the disciplines involved have equal status, something that Bammer (2013: 5) has described as one of a number of 'growing pockets of dogma'. They also call into question assumptions that the development of adaptive and more collaborative teams is *of itself* a guarantee of more effective working.

The analysis in this chapter suggests that the situation is a good deal more complex than it is often assumed to be and that the terminological challenges that have thus far been seen as barriers to effective interdisciplinary work count for relatively little in the context of much more subtle disciplinary asymmetries that can serve to undermine the legitimacy of contributions from one disciplinary source while privileging those of another. The challenge of bringing together very different disciplines has already been noted by Calvert and Fujimura (2011: 162), who warn that 'different disciplinary epistemic commitments could be major stumbling blocks to collaborations in systems biology', but the precise nature of the problem has not up to now been recognised. It may be that it is most acute in this particular discipline, but that is no reason to exclude the possibility that it might apply elsewhere, even where the disciplines involved are more closely aligned.

References

Aderem, A. (2005). Systems biology: Its practice and challenges. *Cell, 121*, 511–513.

Agrawal, A. (1999). New institute to study systems biology. *Nature Biotechnology, 17*, 743–744.

Bammer, G. (2013). *Disciplining interdisciplinarity: Integration and implementation sciences for researching complex real-world problems*. Canberra: Australian National University E Press.

Benwell, B., & Stokoe, E. (2006). *Discourse and identity*. Edinburgh: Edinburgh University Press.

Calvert, J., & Fujimura, J. H. (2011). Calculating life? Duelling discourses in interdisciplinary systems biology. *Studies in History and Philosophy of Biological and Biomedical Sciences, 42*, 155–163.

Creamer, E. G. (2005). Insight from multiple disciplinary angles: A case study of an interdisciplinary research team. *New Directions in Teaching and Learning, 102*, 37–44.

Fasulo, A., & Zucchermaglio, C. (2002). My selves and I: Identity markers in work meeting talk. *Journal of Pragmatics, 34*, 1119–1144.

Gerholm, T. (1990). On tacit knowledge in academia. *European Journal of Education, 25*(3), 263–271.

Heritage, J. (1984). A change-of-state token and aspects of its sequential placement. In J. M. Atkinson & J. Heritage (Eds.), *Structures of social action: Studies in conversation analysis* (pp. 299–345). Cambridge: Cambridge University Press.

Heritage, J. (2012). The epistemic engine: Sequence organization and territories of knowledge. *Research on Language and Social Interaction, 45*(1), 30–52.

Jefferson, G. (1989). Preliminary notes on a possible metric which provides for a ‘standard maximum’ silence of approximately one second in conversation. In D. Roger & P. Bull (Eds.), *Conversation* (pp. 166–196). Clevedon: Multilingual Matters.

Jovchelovitch, S. (2007). *Knowledge in context: Representations, community and culture*. London: Routledge.

Katze, M. G. (2013). Preface. In M. G. Katze (Ed.), *Systems biology* (pp. v–x). Berlin: Springer-Verlag.

Kirschner, M. W. (2005). The meaning of systems biology. *Cell, 121*(4), 503–504.

Kogan, M. (2000). Higher education communities and academic identities. *Higher Education Quarterly, 54*(3), 207–216.

Lawler, S. (2014). *Identity: Sociological perspectives* (2nd ed.). Cambridge: Polity Press.

Lindström, A., & Mondada, L. (2009). Assessments in social interaction: Introduction to the special issue. *Research on Language and Social Interaction, 42*(4), 299–308.

Morrison, P. S., Dobie, G., & McDonald, F. J. (2003). Research collaboration among university scientists. *Higher Education Research & Development, 22*(3), 275–296.

Myers, G. (1990). *Writing biology: Texts in the construction of scientific knowledge*. Madison: University of Wisconsin Press.

Pomerantz, A. (1984). Agreeing and disagreeing with assessments: Some features of preferred/dispreferred turn shapes. In J. M. Atkinson & J. Heritage (Eds.), *Structures of social action: Studies in conversation analysis* (pp. 57–101). Cambridge: Cambridge University Press.

Sacks, H. (1992). In G. Jefferson (Ed.), *Lectures on conversation* (Vol. 1). Oxford: Blackwell.

Schegloff, E. A. (1982). Discourse as an interactional achievement: Some uses of 'uh huh' and other things that come between sentences. In E. A. Schegloff & D. Tannen (Eds.), *Analyzing discourse: Text and talk* (pp. 71–93). Washington, DC: Georgetown University Press.

Schegloff, E. A. (1987). Between micro and macro: Contexts and other connections. In J. C. Alexander, B. Giesen, R. Münch, & N. J. Smelser (Eds.), *The micro-macro link* (pp. 207–234). Berkeley: University of California Press.

Stivers, T., & Rossano, F. (2010). Mobilizing response. *Research on Language and Social Interaction, 43*(1), 3–31.

Stivers, T., Mondada, L., & Steensig, J. (2011). Knowledge, morality and affiliation in social interaction. In T. Stivers, L. Mondada, & J. Steensig (Eds.), *The morality of knowledge in conversation* (pp. 3–24). Cambridge: Cambridge University Press.

Tajfel, H. (1982). *Social identity and intergroup relations*. Cambridge: Cambridge University Press.

Thomas, J. (1984). Cross-cultural discourse as 'unequal encounter': Towards a pragmatic analysis. *Applied Linguistics, 5*(3), 226–235.

Tracy, K., & Naughton, J. M. (2000). Institutional identity-work: A better lens. In J. Coupland (Ed.), *Small talk* (pp. 62–83). Harlow: Longman.

8

How Leadership Works

Introduction

Successful interdisciplinary teams depend on successful leadership. This chapter reveals the many forms this leadership can take in research project meetings and identifies interactional features that are characteristic of successful engagement, contributing to relevant research outcomes.

The chapter begins with a brief overview of different perspectives on leadership and describes the approach adopted in our exploration of how leadership works in research groups, which adopts the perspective of discursive leadership as distinct from psychological approaches to the topic. A discursive approach to leadership conceptualises it as emergent and as a 'co-constructed iterative phenomenon that is socially accomplished through linguistic interaction' (Tourish 2007: 1733), which distinguishes it from approaches that seek to understand it in terms of traits, behaviours, influence, role relationships and the occupation of an institutional position.

Although both the traditional one-way top-down influence process and the non-traditional non-hierarchical leadership process (e.g. distributed leadership) are found throughout the discourse of research project meetings in our data, our focus lies on the discursive ways in which leadership

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activities and processes such as decision-making, negotiating and reaching consensus are conjointly enacted amongst the research team members. This joint negotiation and enactment is particularly obvious where teams have no officially designated person responsible for executing leadership activities despite the hierarchical standings within the group and the institution. Moreover, the exploratory nature of interdisciplinary research collaborations amongst academics exposes the members to different aspects of leadership such as expertise in discipline-specific knowledge and practice, hierarchical standings within and outside the group, and experience in research project management as principal investigators (PIs).

This chapter thus explores the dynamics and effects of how different forms of leadership work are instantiated through the research interactions, teasing out the impact of this leadership on interdisciplinary research collaborations.

Leadership Review

Leadership, in its simplest form, involves establishing direction and supporting individuals in working together to move in that direction. Traditionally, theories of leadership framed the tasks as the relationship between leaders, followers and common goals (Bass 1985, 2008; Bennis 1996; Burns 1978; Hersey and Blanchard 1969; House 1971). Central to this long-standing theoretical view of leadership that has often been the focus of study is leader-centrism, where a single individual provides direction and inspiration to a group of followers. This vertical, top-down relationship (e.g. leader-follower-common goals) where command, control and persuasion strategies are the levers of change (Antonakis et al. 2004; Gardner 1990; Northouse 2004; Rost 1991) has been challenged. In reality, leadership rarely plays out at only the individual level, and in practice leadership and influence may also come from informal and emergent groups of workers (Friedrich et al. 2009; Uhl-Bien et al. 2007). Informal groups, for example, can change policy, or emergent team dynamics can generate creative ideas without substantive help from formal leaders. Thus, the conceptualisation of leadership in recent years has changed its focus from traditional vertical, hierarchical leadership towards more horizontal, collective processes (Gronn 2002; Pearce and Conger 2003; Gordon 2010; Yammarino et al. 2012). Increasingly, more attention is paid to the critical view that leadership is a complex and dynamic process in which the behavioural attributes that often fall under the leadership umbrella may be taken up by multiple individuals almost in spite of their positions, generating a number of different theories under the broad concept of *distributed leadership* (DL), which includes 'emergent leadership', 'shared leadership', 'dispersed leadership', 'collective leadership' and 'team leadership' (Gronn 2002; Day et al. 2004; Drath et al. 2008; Friedrich et al. 2009; Pearce and Conger 2003; Uhl-Bien 2006; Uhl-Bien et al. 2007). The general characteristics shared by these different theories and practices of DL are that leadership is not just a top-down process between the formal leader and the team and that there can be multiple leaders within a group. In a review of the literature on DL, Bennett et al. (2003: 7) identify the following three main premises that underlie these assumptions:

1. Leadership is an emergent property or network of interacting individuals.
2. There is openness to the boundaries of leadership.
3. Varieties of expertise are distributed across the many, not the few.

In subscribing to the concept of a DL process, this chapter focuses on the selective and dynamic emergence of individuals whose skills and expertise are most appropriate to a given situation, and on aspects of directionality and alignment that reflect their commitment to work in teams and to develop community.

Distributed Leadership Forms in Interdisciplinary Research Teams

Despite the prevalence of boundary crossing in interdisciplinary research in higher education, relatively little research focuses on the nature and role of DL phenomena in such collaborative research contexts (Choi and Schnurr 2014; Gray 2008; Mailhot et al. 2016). Interdisciplinary research necessarily requires the collaboration of people with different disciplinary expertise, skills and legitimacy, who come together to create and develop knowledge and are linked by fluid, diffuse and non-hierarchical power relationships. Each individual in an interdisciplinary research team is expected to contribute towards the agreed collective goals regardless of his or her rank and position within and outside the team. In such collaborative interdisciplinary research settings, the need for leadership to be 'distributed' (Gronn 2002; Bolden 2011) or 'shared' (Pearce and Conger 2003) would seem to be particularly evident.

For the success of interdisciplinary research and team effectiveness, all team members, as member-leaders, are expected to carry responsibility for team processes and outcomes, thereby enacting formal and informal leadership roles or behaviours that shift according to the situation. Given the nature of interdisciplinary research, in which disciplinary expertise most often overrides people's positions when resolving problems and deciding future actions (see Chaps. 5 and 6), the nature of the problem to be solved demands somewhat equal participation and responsibility from all team members, with changing leadership (Choi and Schnurr 2014). However, as Leithwood et al. (2006) suggest, although there is much overlap between concepts of a number of different DL theories such as 'shared', 'collaborative', 'dispersed', 'democratic and participative' leadership, this does not mean all forms are equal and/or equivalent, or that every individual is a leader. While acknowledging the essence of DL that allows 'leadership capacity' (Day et al. 2004) where all team members may participate in the leadership process as a member-leader or emergent leader, we need to be more specific about *what* is being distributed, *how* leadership is distributed and *who* controls this distribution. In order to better understand DL patterns and processes, it is important to explore how particular configurations of DL contribute towards, or inhibit, organisational performance (Bolden 2011). Perhaps it is more important to identify and explain situations in terms of *whe*n and *how* DL can emerge successfully without ignoring the importance of the focal leader when considering the questions of *how*s, *what*s, and *who*s in DL process in a given context.

A number of studies show that some form of both the top-down and collectivistic leadership is necessary in that together they contribute towards the team's effectiveness. Mehra et al. (2006) report that team effectiveness does not arise from simply the distribution of the leadership role that is beneficial to team performance, but also comes from coordinated efforts between focal and emergent leaders. Further, research on the relationship between vertical and shared leadership also indicates that while both shared and vertical leadership contribute to team performance, a vertical relationship remains a significant contributor to team success (e.g. Ensley et al. 2006; Pearce and Sims 2002). In the light of this, Friedrich et al. (2009, 2016) take an integrative approach that incorporates processes from several collectivistic leadership theories as well as focal leadership theories (i.e. trait- and skills-based leadership). In this, the collective leadership framework integrates both vertical and collectivistic approaches to leadership in which the focal leader, or leaders, seek to create an environment in which individuals may emerge into informal leadership roles. While these studies draw on a DL perspective, which offers a transition from an individualistic to a social process view of leadership where leadership is something that can be distributed, what distinguishes them from other distributed or collectivistic theories is their underlying assumption that the focal leader or set of leaders will play a key role. Thus, what seems to be the key in the DL process is to recognise the balance between individual, collective and situational aspects of the leadership process and, importantly, when and why particular configurations are more effective and/or desirable than others.

Within higher education, leadership practice can be considered as a 'blend' of vertical, horizontal and emergent influence and direction rather than a 'one-size-fits-all' phenomenon. Bolden et al. (2008, 2009) in their study of the ways in which leadership is distributed within UK universities identify multiple 'hybrid configurations' of leadership forms (Gronn 2010) that are identifiable based on five interconnected dimensions of leadership practice (personal, social, structural, contextual and developmental). A more systemic perspective on leadership, which considers it as broadly dispersed within an interconnected network of people and processes, reveals not only the multiplicity of actors but also the significance of context in determining an appropriate leadership approach (Middlehurst et al. 2009). Ball's (2007: 474) study of research leadership, for example, identifies the following views of research leadership that are different from leadership in general:

- Leadership is both formal and informal and varies according to social systems.
- Leadership is dispersed.
- Self-leadership is a feature of academic researchers.
- Leadership is complex and consists of many relationship patterns.
- Leadership is concerned with the leadership of people and the leadership of the subject.
- Leadership is different from management but there are overlaps.
- Each leader possesses different characteristics and offers different services.
- Leadership is important to the undertaking of research.
- Context of leadership is complicated but is crucial.

A systemic perspective, then, draws attention to the importance of contextual, structural and cultural aspects in determining the extent to which specific forms of leadership emerge and the discursive significance of leadership in making sense of the nature and purpose of academic and managerial work.

Discursive Approaches to Leadership

The very concept of DL suggests that leadership is not a property of any one person. Rather, it is a *process* jointly accomplished by both leaders and non-leaders through the dynamics of interaction in the presence of mutual influence in a given social situation. Fundamentally, it is an ongoing process of becoming rather than a finished accomplishment, so leadership can be distributed and open to challenge. Through this dynamic interaction process leadership emerges, and the key contributor in this is language. The issue then is the nature of the important role that linguistic and communicative resources play in the enactment and social construction of leadership.

Discursive approaches to leadership focus on language in use, interaction process and/or discursive formations (Fairhurst 2007, 2009) to understand how leadership is dialogically achieved in interaction. According to Clifton (2012: 149), discursive approaches to leadership can be summed up as approaches to leadership that consider it to be a language game in which meaning is managed. Thus, those who emerge as leaders are those who have most access to more powerful discursive resources with which to influence the process of the negotiation of meaning (Clifton 2015: 150). This echoes the view that such processes of meaning negotiation or management are fundamentally mediated by power, which is, for Mumby (2001), seen as a defining, ubiquitous feature of organisational life. The underlying source of power may vary and different contexts necessitate different forms of power, but in order to understand the actual processes through which leadership is realised in an interactional context where language (or communication), power and organisation are interdependent, there is a need for discursive approaches, in particular those examining the micro-dynamics of communication.

Studies reflecting a discursive construction of leadership in recent years have used broadly discourse analytic tools such as discourse analysis, conversational analysis and/or a combination of social constructionism and fine-grained analyses of talk to explicate how leadership emerges and meaning is managed on a turn-by-turn micro-level interaction (e.g. Baxter 2010; Choi and Schnurr 2014; Clifton 2006, 2015; Holmes et al. 2011; Nielsen 2009; Schnurr and Chan 2011; Svennevig 2008; Wodak et al. 2011). Working within this tradition, we analyse naturally occurring interdisciplinary research meeting talk in order to describe and explicate the emerging patterns of the different forms of leadership processes in systems biology research meeting interaction, as well as the nature of the emergent leader and leadership processes through which meaning is managed in various situations.

Analysis

This section identifies three aspects of leadership that are found in three different systems biology interdisciplinary research project meetings: the emergence of leaders and the DL process; traits of traditional authoritative leadership; patterns of blended leadership situations.

Distributed Leadership

The context in which the DL process is observed and leaders emerge varies, but the purpose and objectives of individuals and the group drives the emergence of leaders in the process. The first example describes how DL is enacted conjointly and discursively in a context where mutual respect is present; the second and third examples illustrate the underlying factors contributing to the emergence of an individual as a leader.

Emergence of DL

Extracts 8.1 and 8.2 illustrate very clearly the enactment of DL in a team. Regardless of their hierarchical standing, all participants perform a leadership role in reaching a consensus conjointly and discursively. In Extract 8.1 Roy has presented interesting data that the team members had not seen before, and they have been exploring ways to account for the observed behaviour in the data.

Extract 8.1

Roy:	so our chip seq data is more close to our micro array let's say.
Carl:	Yeah quite a <u>lot</u> more
Mark:	and that's <u>good</u> and that fits with why you would get some
	discrepancies with Sam's so that's very good.
Carl:	So the real question then is whether the erm remaining genes
	are just <u>indirect</u> targets then
	(3.0)
Paul:	Your FD could be acting over distance [it's hard to match binding
Carl:	[Or it could it could be that
Paul:	sites to target genes
Carl:	they haven't got enough bind- that we just haven't got a big
	enough yeah.
Paul:	It could even come from a different chromosome lots of binding
	sites we don't know whether they have an effect at all.

Roy: Probably another assumption we can make for this table is that should the proportion of genes at different time is not that different.
Carl: What?
Roy: If you compare
Carl: Oh right yeah yeah
Roy: somehow it grows for pulse but goes down for continuous
(7.0)
Ok this [*is*]probably all the numbers I wanted to show and now we can discuss the plant
Paul: Just one thing if you go to 2600 genes for erm peaks for Sam or genes did you base this on the same number of peaks in both datasets?
Roy: Yeah five thousand top peaks
Paul: Yeah
Mark: Sorry just in case I probably missed this what about down regulated genes
Roy: I didn't do it for down regulated
Mark: Ok
Roy: but I can do it.
Mark: You should that would be just you should.
Carl: Yeah yeah and I think you should relax this 10kb thing just take everything upstream or and downstream do just do the two cases upstream and the other case downstream.
(WSBNF0415-00:35:32)

The extract begins with Roy's assessment of the analysis that he has presented so far and opens the floor for discussion when he says 'so our chip seq data is more close to our microarray let's say' (l.1). Both Mark and Carl agree with Roy's view, and while Mark sums up the discrepancies between Roy's and Sam's data (l.4), Carl comes in with the 'real question' initiating creative thinking as Paul and Carl, both from the dry camp, explore the 'real question' with upshots (ll.8–24). However, it is Roy who helps to guide the discussion and bring it close to the data by giving them his assumption about the data sets (ll.15–17, 19, and 21). He then effectively closes his presentation and suggests the next topic of discussion by saying 'this is all the numbers I wanted to show and now we can discuss the plant' (ll.23 and 24). Paul continues to probe the question from a dry perspective when Mark comes in with an experimental question about 'down regulated genes' (l.30), and with the agreement from Carl, Mark effectively tasks Roy to do the analysis (ll.35–38). Mark's question about the down regulated genes leads the discussion towards the conclusion, where Paul steps in and closes the discussion. This is illustrated in Extract 8.2.

Extract 8.2

01	Paul:	So I think our data is <u>fine</u> because we have a strong (xxx) motifs
02		we have lots of consistency with Sam's data and our data seems
03		to link to the micro array data as well.
04	Mark:	We've got a good dataset
05	Paul:	And the the peaks are much more I think they're more <u>crisp</u>
06		they're sharper than you would expect after secondary
07		fragmentation I thought they would be much more blurred but
08		the majority of them [(xxxxxxxxxxxxxxxxx)]
09	Carl:	[Yeah you would expect] that erm
10	Mark:	That's very encouraging
11	Paul:	So we don't quite understand <u>why</u> it works but it does work so
12		Peter suggested earlier and I discussed it with him we shouldn't
13		worry about it if it works then we should just go ahead and get
14		our (xxx).
15	Mark:	I think that's right I think if something's working
16	Paul:	He doesn't quite understand it <u>either</u> why the peaks are not a bit
17		wider
18		(4.0)
		(WSBNF0415-00:37:27)

Paul takes the lead to conclude the discussion with a summary from a primarily dry perspective, drawing on support from an expert with whom he has consulted. Both Mark and Carl seem happy with Paul's conclusion (after line 18 the team move on to a new topic). What is interesting about Extract 8.2 is that Carl, who is the expert in this kind of dry subject in the team, takes a backseat and it is Paul, an associate professor, who takes on the role of closing the discussion. This is an example of an emerging leader in a DL context.

This arises from a discussion in which all participants perform leadership actions: Carl identifies the 'real questions', providing a focus, Mark contributes evaluation (l.3 in Extract 8.1, ll.4, 10, 15 in Extract 8.2), which would normally be the preserve of the leader, and Roy initiates a subtopic. It is worth remarking in passing on the way in which each participant takes responsibility for a different leadership action. Just as importantly, these actions are embedded naturally within the evolving discussion.

More specific points might be made. Roy establishes an interesting problem for discussion and facilitates it throughout by providing relevant information at key points; he also steps in to show agency and commitment by initiating the task that was suggested by Mark. Mark's leadership behaviour is also clearly demonstrated when he suggests an idea about downregulated genes and effectively assigns responsibility for the step to Roy. Carl's role as stimulator or knowledge driver for the team is a reflection of his knowledge and experience in the field as one of the world's leading figures in systems biology. Thus, extracts 8.1 and 8.2 very neatly illustrate the potential of leadership capacity in teams (Day et al. 2004). The distribution of different types of leadership performed by each member of the team accomplishes the enactment of DL conjointly and discursively.

Emerging Leaders: Facilitating Discussion

Extract 8.3 follows extract 8.1 in which Mark directs the team to what they need to think about as the result of Roy's data. It begins with Paul's response to Mark's suggestion of what needs to be considered in order to understand Roy's data, and he provides his reasons why looking at AA is a better option than looking at the transcription factor (ll.1–5 and 8–9). Mark accepts Paul's reasoning (ll.9 and 11) and they both engage in the interpretation and upshots but both of them admit that they have not seen such data before and that they cannot understand the behaviour of the data (l.12 'but I wouldn't know'; l.19 'I don't know, I don't know'). Roy steps in and proposes showing them more findings from the data as Paul and Mark discuss possible interpretations and Mark is even ready to 'suggest something' (l.32).

Extract 8.3

01 Paul: But we haven't got a we've got at this point but obviously there is
02 genomic DNA that hasn't precipitated specifically exactly at the
03 exomes or whether the transcript has actually been reversed
04 transcribed to DNA (xxx) but I think the latter is more likely
05 because the peaks are very very angular and precise on the
06 exomes
07 Mark: Yeah ok
08 Paul: It was precipitation of fragments in both exomes I think [it would
09 Mark: [I think
10 Paul: be more spread out]
11 Mark: you're right actually]
12 Paul: But I wouldn't know why you would have reverse transcription
13 specifically of the AA transcript and not of most others why
14 would it be just this transcript that's reversed transcribed.
15 Mark: It sort of suggests that even if it's an artefact that it's telling us
16 something that's unique to AA that will probably is something
17 we don't know about
18 Paul: Maybe have the reversed transpose on the machinery for that or.
19 Mark: I don't know I don't know.
20 Roy: Ok let me show you a few more

[9 lines omitted]

30 Mark: Ok well that's the only one I'd ask about really since it's.
31 Emma: I don't think we looked at that earlier did we.
32 Mark: It's very interesting it's I would just suggest something
33 Roy: FD1 or
34 Mark: No ok (…) very interesting.
35 Carl: So I suppose to get the the real issue is what to do what to do
36 next right I mean how to proceed now
37 Roy: Yeah can can I show just a few more
38 Carl: Yeah go ahead
(WSBNF0415-00:22:46)

Both Paul and Mark are unsure about what to make about the data and Roy's suggestion of 'ok, let me show you a few more' helps the discussion forward. This extract reveals how even though Roy orients to Carl as the leader, as exemplified in the adjacency pair in lines 37 and 38, Roy is nevertheless able to take responsibility for steering the discussion in a certain direction driven by his perspective. That is, Roy manages the discussion floor by keeping it close to his findings to ensure that the discussion and any potential decision that may result from it aligns with the assumption on the basis of which he generated his results. This will help him in carrying out any further steps resulting from the discussion in order to build on his work so far.

Emerging Leaders: Steering an Idea

Extract 8.4 is an example of a post-doctoral researcher, Anne, as the central actor despite her position, showing how she is able to steer the discussion in a direction that will enable her to achieve her experimental goals. This 'steering' is a form of leadership behaviour that is subtle rather than overt and is legitimised by the shared goal of taking the experiment forward. Although both Roy in Extract 8.3 and Anne in Extract 8.4 'steer' the discussion in a certain direction for the benefit of their own work and for the project, the context and the nature of steering is different. On the one hand, Roy in Extract 8.3 facilitates progress in the discussion by stepping in at a time when the professors are ready to make somewhat premature suggestions, offering additional examples for consideration. Anne, on the other hand, engages in the discussion and steers it discursively in a certain direction in order to arrive at a solution to her problem that she can work with. She achieves this by involving both the PI and Co-I (co-investigator) in the conjoint construction of a solution.

The example comes from another biology research project in systems biology involving wets (biologists) and dries (mathematician, statistician and bioinformatician) in a team that have been working together for a year and half on a three-year project. As a result, norms relating to the way meetings are run are by now well established: the approach is fairly informal with no designated leader for the meeting despite the presence of the PI and several Co-Is.

Anne is seeking direction from the team on plotting genes that she believes interesting and necessary (Extract 8.4(1)), but she is unsure about whether or not to proceed and how to proceed (ll.2–3). Kate offers advice which Anne initially questions, prompting further explanation from Kate (l.4–17) that is received slightly doubtfully by Anne (l.18). At this point, Sue (a statistician) joins the conversation and directs a number of questions to Anne in order to understand Anne's problem (l.21). From this moment on Sue takes control of the discussion and asks more questions in order to understand and help Anne (ll.21–36). As Sue is about to offer a suggestion, Anne asks a question to which Kate responds. Anne has proposed a way of doing it (l.38) which Kate rejects (ll.41–44), suggesting an approach and asking Anne whether that is possible. When Anne says it is easy (l.45), Kate concludes the exchange with a brief acknowledging check (l.46).

Extract 8.4(1)

Sue: It looks quite good doesn't it I think
Anne: Yeah yeah. The one thing though we are plotting probes so I
should actually get down to plotting genes shouldn't I
Kate: Well it's not necessary I mean until you
Anne: But I should just do the average of the probes for a gene or is
the the wrong thing to do
Kate: No if you want to know if you want to recover them as being
differentially [expressed they will drop off your list once you get
Anne: [Umm
Kate: the threshold
Mary: Yeah but this is my data
Anne: Yeah but so but if one gene has say three probes and two of
them are different only one is differentially expressed what
would you call that differentially expressed or should I take the
average of all probes and do differential [expression
Kate: [Well hopefully you
would get it three times. [((laugh))
Anne: [Umm ((doubtfull))
(0.3)
Kate: Erm

21 Sue: What are you talking about now what's [probes now
22 Anne: [So because on the array
23 I mean you can have we will have some genes so we just basically
24 have these nucleotides so probes to detect the gene right?
25 Sue: So what have you plotted there then [(xxx)
26 Anne: [These are probes so gene
27 one can have between one to five probes sometimes
28 Sue: Emm
29 Anne: (…) so now I plotted all the probes (0.2)
30 Sue: Together
31 Anne: Yes (.) so the [question is
32 Sue: [As an average of what
33 Anne: No all the pr- just all the probes I haven't taken care of whether
34 they're one gene or two genes. (…) so
35 Sue: Oh ok.
36 Anne: Yeah
37 Sue: Maybe what we should do [is
38 Anne: [Should I do an average here
39 Kate: Yeah
40 Anne: And then sort of translate it [into the gene world
41 Kate: [No no no no do it probe by probe
42 but do your ranking erm then pick out all the ones that are
43 differentially expressed then retrieve the data for the other
44 probes there must be a way to do that
45 Anne: Yeah that's easy
46 Kate: Yeah?

However, neither Kate nor Anne are satisfied with Kate's last suggestion, so Kate attempts another suggestion (Extract 8.4(2), ll.51–53) following Sue's question to Anne checking whether she wants to look at single probes (ll.48–49). This time, Kate's suggestion is opposed by Sue, who suggests that Anne could do both single and all the probes (l.55). When Anne agrees to do both, Kate also agrees (l.58) and once Anne has agreed to do both the discussion continues on the statistical details until Anne is satisfied with the solution that Anne and Sue have constructed (ll.108–111). This solution will help Anne to analyse the data more effectively as she can see the genes more easily (ll.117–118).

Extract 8.4(2)

Anne: It’s just a
Sue: So you want to treat you want to look at the probes keep on
looking at the single probes
Anne: And that’s what I’m wondering [what’s the best way
Kate: [I think I would I would look at
the single probes and then hopefully you get more than one
>you know< [it’s just the amount of evidence isn’t it
Sue: [Well
Sue: Yeah but also you could you could do both right you can erm
Anne: Yeah I could do both
Sue: You do the analysis for the probes and all of that.
Kate: Yeah you could [do both yeah.
Sue: [And so once you’ve got your [protocol
Anne: [Yeah
Sue: for doing that it won’t you should you could do the average for
the for each gene or take the median if you’ve got five probes or
so
Anne: Yeah some have most of them have one some have two some
have three some have four or five so you’re saying median is
better than the mean
Sue: [Usually yeah
Kate: [So we don’t (xxx) use we use the same arrays erm (…) But there
are other people have used other arrays with presumably
multiple probes
Anne: Yeah
Kate: Have you talked to people (xxx)
Sue: I think what [they usually use quan]tiles
Anne: [They usually do they]
Sue: rather [than averages because they don’t have (xxx)
Anne: [Yeah yeah they don’t do it yeah yeah
Sue: Yeah
Anne: So they usually I mean they usually combine the data I think
I think for many people do analysis on genes and not on probes.
Mary: Umm
Kate: Yeah
Anne: Yeah
Kate: So the average then you mean
Anne: Or take the median

Kate: [the median yeah
Sue: I think they don't I mean the average again it has the same
problem if you've got [say
Anne: [Outliers
Sue: If you take the five probes and one is an outlier it will [you know
Kate: [Yeah
Sue: influence
Kate: and how do you (xxx) gene
Anne: Some? Huh? no the maximum I think I've seen is five but very
many of them just have one probe
Kate: Yes because I was going to say how can you do median when
there are three erm
Sue: Erm then you take the middle one.
Anne: Yeah
Kate: Yeah
Sue: But three is easy.
Anne: Three is fine odd the- the even numbers are the the the tri tricky
ones the even numbers are fine it's always the mid- no odd
numbers
Sue: Three is fine if you've got five you take erm (0.3) the third if
you've got four you take the average between the
Anne: The [two middle ones
Sue: [Number two the two middle ones
Anne: And the same with two you take the average [yeah so that's yeah
Sue: [Yeah
Kate: [Umm
Anne: so that's yeah (.) so that would help.
Kate: (xxx) looks some data sets I've seen where they just treat them
individually I think you know so that's why some time a gene
comes up more than once in a list
Anne: Yeah I've had that too depends yeah (…) no ok ok I can do both
just to see if it makes a big difference but erm (0.2) I [find it very
Sue: [It shouldn't
make a difference but [even though it should make it easier to
Anne: [No
Sue: look at the genes
Anne: Yeah it's easier to detect I mean its eas- what we're interested in
is genes and not really probes
Sue: Yeah

124 Anne: so by doing a gene centric analysis its somehow easier to get into
125 gene stuff but I mean I will have to translate everything to gene
126 mode [afterwards anyway]
127 Kate: [But then (xxxxx)] for some probes than for others
128 Anne: Yeah umm s::o
129 Kate: Then you you <u>should</u> get the same with all of them but
130 Sue: But by taking the <u>median</u> of the probes you will also probably
131 have less <u>outliers</u> than these plots.
132 Anne: Probably
133 Kate: Yeah.
(WSBLH0401-00:51:23)

This extract illustrates how Anne carries on the discussion until she arrives at a solution that helps her to see the data more easily. Although she receives several suggestions from Kate that could easily have discouraged Anne from pursuing her idea of what could potentially be interesting and worthwhile, her persistence pays off in the end as she achieves what she was hoping for with the help from Sue. This demonstrates a number of leadership acts from Anne motivated by her commitment to the project. She works hard to find ways to process data more effectively. Even though she is a post-doctoral researcher, the fact that she is the only dry post-doctoral fellow to carry out day-to-day analyses and modelling means that her knowledge of the data is superior to that of the PI and Co-Is. Significantly, the academic hierarchy within the team does not seem to prevent or hinder her in steering the discussion with confidence for her own benefit and thereby for that of the project. In doing so, she involves the PI (Kate) and the Co-I (Sue) in constructing a solution collaboratively. The exchanges in this extract also reveal not only the asymmetries in disciplinary knowledge between the wets (Kate) and dries (Anne and Sue) and but also the power of disciplinary knowledge over seniority. Anne's self-interest as a researcher drives her to emerge as a leader in this context.

The Individual and the Group

The word 'distributed' itself implies there is an agent who controls or 'dishes out' roles (top-down), rather than being an organically formed arrangement in which the situation brings about leadership discursively (bottom-up and/or horizontal). However, the cases we have described in this section suggest that the fundamental feature that drives and necessitates the emergence of leaders in DL is not one in which an individual controls and distributes leadership roles but one informed by the group and the context. The exploration of new knowledge and science necessarily involves a group of individuals with distinct expertise, which allows an individual to emerge as a leader where particular circumstances make this appropriate in order to facilitate the collaborative construction and creation of knowledge. Thus, what seems to be the key in a DL process is to recognise the balance between individual, collective and situational aspects of the leadership process as well as the dynamics of power and influence derived from individuals' expert knowledge and not from individuals' standing. It is also important to understand when and why particular configurations are more effective and/or desirable than others.

Authoritative Leadership

Giving Direction

Extract 8.5 illustrates the traditional individualistic authoritative leadership behaviour of directing tasks and involving members in the discussion. Mark's actions in this extract clearly demonstrate his role as the PI of the project and his expert knowledge in biology. Mark directs the next steps based on Roy's findings by asking Emma to look in the literature for any related work and the team to think about what factors might have affected the finding. Mark's authoritative involvement of the members in his thinking out loud process is possible because of the presence of mutual respect for each member's expertise and positions.

Extract 8.5

Roy: Erm now there is a very interesting case erm just let me
(0.5)
erm sometimes we get erm this kind of peaks which are not ver-
real peaks erm they don't come from erm FD binding it's so
called (xxx) peaks usually they real peaks should be about
Gaussian shape

Mark: Yeah
Roy: I don't know exactly what these are they usually come in erm
repetitive regions these are probably kind of erm not exactly
(xxx) active ones but they're caused by erm repetitive regions.
now I I can feedback them them out but in this data set we
have erm if you look at AA gene we have these rectangular peaks
erm at the exome locations
Mark: Yeah
Roy: So there are very many sequences many fragments which match
exactly the exome exomes of AA and AA is PP I don't know
why there are some repetitive regions its very strange feature
Mark: It's very strange
Roy: In Sam's data there is nothing.
Mark: Never been any suggestion of control through AA.
Roy: So I don't know why it should erm PP exome sequence and to
the data.
Paul: No maybe maybe if reverse transcription happened to AA
transcript the transcript is DNA.
Mark: It is very interesting (…) it's very interesting.
Roy: And its really strong and I think one way exomes are present
(8.0)
Mark: So
(9.0)
there's no data that I'm aware of of any specific control
of AA expression through any sort of feedback
(0.7)
but Emma we ought to just do a check that no one's ever said
anything. Erm but it could of course be more subtle than just a
direct feedback it might be some other buffering process to
maintain AA protein levels at a constant level there may even be
a way of avoiding noise going on I don't know there's a number
of things to think about though that could be potentially very
interesting I mean it might be very important for the cell Carl to
keep AA under a very very sort of almost consistent level with the
sort of you know certain amount of feedback to create consistent
level to [avoid noise and avoid noise.
Carl: [Yeah you could there's no reason why you shoul-couldn't
have negative feedback to maintain a nice equilibrium yeah.
Mark: I mean it's a it's a thought there could be something going on

negative feedback would be probably the thing that would be missed rather than positive feedback.
Carl: Well negative feedback just holds an equilibrium level.
Mark: Yes yeah now erm yeah (…) erm Emma could you do a search in the literature for anything hidden away on that
Emma: Yep
Mark: And what we will try to do is to do a think about ideas about things that might have an effect in terms of transcription translation what could be going on in terms of in that system … (WSBNF0415-00:18:07)

Roy presents interesting findings from his data (ll.1–17) and invites the team to explore and discuss the next steps resulting from the discussion (ll.15–17). He also gives his view about his data compared to Sam's data (l.19), indicating the discrepancy between the two data sets that he doesn't understand (ll.21–22 and 26). Mark's comments in lines 18, 20 and 25 show he is in agreement with Roy's interpretation of the data. After the two consecutive long pauses of 8 seconds and 9 seconds in lines 27 and 29, he immediately performs his leadership role. In his turn (ll.30–34) that seems to involve his thinking out loud, Mark states the interesting aspect of the data and involves Emma in indicating a possible next step. He then responds to Paul's suggestion (ll.23–24) and explains what might be happening. He also brings in Carl to draw on his expertise on the cell (l.39) and after exchanging ideas with Carl (ll.43–48) he asks Emma to do a literature search for related findings (ll.49–50). He then turns to the team inviting them to explore Roy's data together.

Mark's leadership actions from line 30 display a number of interesting patterns of interaction with different members. His response to the data that Roy has presented is authoritative, in that saying that 'there is no data that I'm aware of…' (l.30) implies the assumption that if he is not aware of it neither will the others be. He thus establishes his seniority by displaying his expert knowledge in that area. Mark's superior position in terms of knowledge and status as the PI of the project is further demonstrated by his action towards Emma in asking her to check the relevant literature in lines 33 and 49–50 (the latter clearly directive), thus exercising his authoritative leadership. His response to Paul and exchanges with Carl, on the other hand, are more like exchanges of views or ideas. Mark accepts Paul's suggestion (ll.23–24) by saying ‘it <u>could</u> be more <u>subtle</u> than just a direct feedback …’ and adds more possible interpretations that might account for the strange feature in Roy’s data (ll.34–38). Mark then seeks Carl’s views on the cell and feedback, and they explore the idea of the possible presence of negative feedback. Thus, Mark’s different interaction styles with Emma on the one hand and Paul and Carl on the other are clearly influenced by the hierarchical considerations related to the participants’ knowledge and standing. Leadership interaction here is influenced by the power of knowledge and seniority, but this needs to be seen in the context of the ways in which Mark brings the members into the discussion, drawing on each participant’s qualities in order to contribute to the overall objectives of the project.

Time Management

Another example of leadership that reflects an individual’s position comes from a three-year project that has only a month left to run. At the third from last meeting of the three-year project, the biologist PI Kate controls the discussion by reminding the team of the time constraints of the meeting (Extract 8.6). One of the team members, Anne, has already left the university, so she has joined this meeting via Skype. The purpose of the meeting is to see where they are in terms of the data that they have analysed so far and how they can use these usefully for their journal papers as the outcomes of their project.

Extract 8.6

01	Carl:	They’ve just been they just been turned on because CH is not
02		there any more (0.2). So that’s relief of repression, the question
03		is how far <u>back</u> it is going
04		(0.5)
05	Kate:	But there can be other mechanisms too. And CH is not, like (xxx)
06		<u>sto</u>ry
07	Carl:	No, no. That’s right. So that’s what we’ll, with … I mean (0.2) that’s
08		what we’re trying to work out. Isn’t it? I mean, the point is, if CH
09		is not doing anything then erm
10	Kate:	Yeah.

11 Carl: because of other effects, the question is, if it isn't doing
12 something, so what is it? Is it that it's turning the gene off, or is it
13 relieving it from repression?
14 Kate: I think, the thing is, do we want to get started on this now
15 (0.3)
16 Because we have limited time
17 Carl: Yeah >I know< that's a good point
18 (0.3)
19 Kate: So:: maybe we should just focus on what we've got. for the time
20 being.

[14 lines omitted]

35 Kate: Yeah. Mm-hmm (affirmative) Could we …
36 Carl: I mean you have [only I mean
37 Kate: [Just, could we just remember this question and
38 put it in the corner for now? Just finish off the chip seq analysis
39 and whatever we want to do first.
40 Anne: Yeah. I don't have any reason-
41 Kate: I'm just concerned about sort of, uh:: You know, to waste time
42 and things like that.
(WSBLH130426-00:42:08)

The team explores the analysis presented by Anne and the discussion generates interest from the team members, especially Carl, the Co-I and senior member of the dry team, who initiates discussion by saying 'the question is, if it isn't doing something, so what is it? Is it that it's turning the gene off, or is it relieving it from repression?' (ll.11–13). At this point Kate, the PI, steps in to remind the team that there isn't the time to explore those questions further at this meeting because this would involve more experiments: 'do we want to get started on this now because we have limited time' (ll.14–16). Even though the question Carl is posing is interesting, Kate is being realistic about the time constraints and more concerned about first discussing the 'chip seq' (ll.37–39) as they are already 40 minutes into the two-hour meeting. One of Kate's priorities in these last project meetings is to tie up any loose ends and wrap up the project, so she is anxious to get on with the actual data and not to 'waste time' (l.41) considering interesting questions that the project cannot pursue given the time constraints. Thus, she asks the team to focus on the topic in hand, and implicit in this is a reminder that there are only a couple of more meetings to go after this meeting. This extract illustrates clearly another form of authoritative leadership in that the force of Kate's actions reflect her PI role within the project, overriding academic claims where these conflict with practical considerations.

Task Management

The final example of authoritative leadership behaviour comes from a five-year project, which involves three different universities in the United Kingdom. This is a substantial project, and the project meetings are necessarily large, involving around 10–30 people at one meeting. The members' positions in this project range from professors to PhD students, and the various specialisms within the broader field of systems biology are represented. Extract 8.7 is from a meeting that took place in one of the three institutions. The PI from this institution is not present at the meeting, so one of the Co-PIs in biology, Joan, is chairing the meeting, which is attended by 11 team members. The team is organising tasks for their next big meeting in July when researchers from all three institutions will meet. In her role as the chair of this meeting and a Co-PI of the project, Joan is making sure the relevant tasks run smoothly. In line 1 she states the importance of achieving the target date, which is July (l.13), emphasising that progress on the task for which Lena, who is not present at this meeting, has responsibility needs to be maintained. So she asks Tim to 'keep a close eye on it' (l.6) to help Lena. Amy provides evidence to support this request by pointing out in line 10 that Lena has many things on the go at the same time and that she may not notice if the program crashes. Twelve minutes later, after having checked that other tasks are all on course, a similar situation arises when Tim volunteers to run another simulation to help the team working towards meeting the July deadline (ll.18–20). Again, Joan is concerned about any delays that might be caused by any system failure and tries to ensure that someone is paying attention to the process (ll.23–24; 28–29).

Extract 8.7

Joan: Yeah so that's a good target to have if we combine (xxx). So it's
really important that Lena gets that stuff done and keeps going
Lucy: What were you doing it now or (xxx)
Tim: Erm Lena's going (xxx)
Lucy: Right ok
Joan: Can you keep a close eye on it
Tim: Uhum
Joan: Make sure it doesn't stop because if something crashes she
might not notice for it I don't know if you but
Amy: She's got lots of courses and things (xxx) the next couple of
weeks as well

[12 minutes of discussion omitted] (00:34:40)

Joan: Ok that would be really good (xxx)
Lucy: Yeah no but then everything would be done by July and we
could then
Joan: Yeah we could get the highlight done on the (xxx) we can't then
(xxx)
Lucy: Yeah
Tim: I could I could maybe start not on the (xxx) which I don't see
(xxx) but if not I can start running a few on the systems (xxx) so
then by by then we should at least have a few genes.
Joan: Yeah well I mean [(xxx)
Lucy: [At least we can run
Joan: just when you're not around presumably erm someone else can
keep going.
Tim: Well on the systems one you can just run it (xxx)
Lucy: Oh ok
Joan: Yeah but ones as soon as (xxx) finished we might as well start
using (xxx) if someone else can do it while you're not here can
you train someone
(0.4)
Lucy: Ken maybe could do it (xxx) ask Pete to do it David not do it
Doug: No (xxx)
Joan: Yeah but the highlight's not Lena's problem (xxx) expect her to
(xxx)
(0.10)
(xxx) So at least if you haven't analysed the data we'll have it by

37 then (xxx) July
38 (0.15)
39 I think that would be great with all that done
40 Lucy: Umm umm
41 Joan: It would be really good be a big milestone
(WSBPR0526-00:22:01)

Joan's leadership actions in urging the team members to keep a close eye on the system where simulations are running reflect again her role as a chairperson in this meeting and her position in the project. An interesting aspect of this extract is Lucy's actions, which clearly show her position as a collaborator supporting the actions of the chairperson. This may be because Lucy also chairs project meetings from time to time, having the same standing as Joan both as a biology Co-PI of the project and in her position as an associate professor. There is a noticeable difference, however, between Joan and Lucy in terms of the language they use. The force of Joan's language is clearly authoritative, lacking the tentativeness that can be found in the contributions of Lucy (l.31) and Tim (1.18). She highlights what is important (l.2 'really important that Lena gets that stuff done and keeps going'), evaluates (l.1 'a good target to have'; l.12 'ok that would be really good'; l.39 'that would be great with all that done'; l.41 'it would be really good be a big milestone') and assigns tasks and responsibilities (l.6 'can you keep a close eye on it'; l.8 'make sure it doesn't stop'; l.29 'can you train someone'). Although Joan may not be the leader of the project, when circumstances require that she deputise for the PI in order to ensure that work is progressing according to plan, she exercises the authoritative leadership that will enable her to fulfil this responsibility.

Leadership Styles

Three very different styles of authoritative leadership have been explored in this section. There is a clear leader in all three extracts who, as a PI or Co-PI with a senior position within the institute, controls the discussions and meetings. Other members of the team orient to this, accepting direction from a single source in a way that is not characteristic of meetings organised on the basis of distributed leadership. Neither does this participation structure allow an opportunity for an individual to emerge as a leader, though it does not deny participants agency. For example, Tim's offer to run another simulation to help the team working towards meeting the July deadline (ll.18–20) in Extract 8.7 is a case in which a PhD student actively participates in working towards the team's agreed objective rather than just waiting to be given a task. What leadership in these three extracts shares with that in DL meetings, however, is the power of knowledge. It is their status as participants with expert knowledge in their field that confers legitimacy on Mark, Kate and Joan as PIs and a Co-PI, allowing them to exercise leadership actions such as managing discussions by involving members (Extract 8.5), firmly reminding the team of the time constraints (Extract 8.6), directing and ensuring tasks are carried out successfully (Extracts 8.5. and 8.7) and so on. The difference between the DL process considered in the previous section and the authoritative leadership illustrated here is that leadership is exercised more subtly in DL contexts compared with the more explicit and overt moves characteristic of authoritative leadership.

Leadership Patterns in Research Project Meetings

The research teams explored in this chapter are from three different research projects varying in the number of members, the levels of expertise and the range of hierarchical standings. These differences play a key role in the way that the members of each team develop norms that influence their interaction and communication with each other as they work together over a period of time. It is the norms that the team establish that serve as the context for the potential emergence of individual leaders and the instantiation of the DL process. Depending on contexts and situations in meetings, different leadership patterns are formed and all three projects reflect the complex nature of leadership instantiation. However, expert knowledge seems to play a more significant role than seniority in terms of the form of the leadership and is particularly prominent in the WSBLH and WSBNF projects, where a 'blended leadership' (i.e. both the horizontal and vertical leadership process) pattern is exhibited. Only the WSBPR project meetings kept to more formal and vertical leadership form.

There is a noticeable difference between the three projects in terms of how the meetings are run in the absence or presence of a chairperson, which seems to be directly related to the size of the team. In the WSBLH and WSBNF projects, there are six team members; the WSBPR project, in contrast, never has less than 10 people present at any one meeting. Thus, unlike the WSBLH meeting, for example, WSBPR meetings require a chairperson to lead the meeting. The fact that the numbers of people present at the meeting will never exceed six in WSBLH and WSBNF meetings, coupled with the fact that these research meetings are exploratory in nature, means that the presence of a chairperson is not formally necessary. Because the WSBNF project involves academics from two universities, it is sometimes led by a chairperson for practical reasons, which is never the case with the WSBLH project where all members are from one university.

Another difference between the three projects arises from the hierarchical standings involved. Of the three projects, WSBPR is the only one that has PhD students on the team. As a result, the way in which the meetings are run in this project is different from that in WSBLH and WSBNF. The key contributing factor is that PhD students, much more so than post-doctoral fellows, require guidance in carrying out research. Therefore, supportive, interpersonal and relational aspects of leadership are more prominent in WSBPR project meetings. Paradoxically, however, the need for a chairperson in such meetings in turn creates a power distance between the chair and other members. Extract 8.8 is an example of the way in which the chairperson performs a developmental function with respect to the PhD student members.

It begins with Joan, the chairperson of the meeting, asking Tim what he is planning to do when he finishes writing a journal article, which he is first authoring together with a team of post-docs and PhD students and which is about to be submitted.

Extract 8.8

01	Joan:	So what are you doing to do next
02	Tim:	Erm well its working through the analysis of the tritus erm gene
03		sets at the moment. erm we're currently also working through

the peg for the publishing the switch model so the methodology
there erm and then we also want to start visualising the switch
data in other ways as well so for instance erm trying to
incorporate it with our gene expression plugger putting the
switch data into that as well erm and start looking for erm
particular (…) links between genes at times of their switches
across the different data sets
Joan: Yeah
Tim: and then hopefully that can go in as I say some sort of
visualisation so we can start looking for if we define a particular
time period of say all of the switches after a particular switch in
a gene say for two hours afterwards we can then start
generating networks of all the other genes which have some sort
of switch point after them and then we can merge all the
different data different data sets together as well
Joan: Yeah
Tim: in those
Joan: Yeah
Tim: That's sort of just ideas at the moment but that should
hopefully
Joan: Yeah that was one of the ideas that switched it wasn't it to see
what common switch x than switch y=
Tim: Yeah=
Joan: =across lots of datasets
Tim: Yeah
Joan: Yeah
Tim: I say it's just sort of in my head at the moment but it [shouldn't
Lucy: [So that
Tim: take too long to sort that out
Lucy: would you erm you see have can you would wigwams inform
you because you're probably going to get lots of
correlations [aren't you
Tim: [Yeah
(WSBPR0526-00:31:54)

Tim outlines an idea that he wants to try (ll.2–22). Joan and Lucy then initiate a series of exchanges lasting 11 minutes in which the team help him to shape his idea by exploring it together with them. This is a common pattern found in WSBPR meetings, in which PIs tend to check doctoral students' ideas and what they plan to do when one job is done, thus ensuring that they continue to develop ideas relevant to the overall project objectives. This is not observed in WSBLH and WSBNF because there are no PhD students in these two projects and the post-docs involved are 'colleagues' whose expertise is respected, rather than students. Thus, vertical asymmetrical power relations feature more prominently in WSBPR. In this non-horizontal leadership context, the role of chairperson as the leader of the meeting includes the responsibility for supporting, guiding and developing PhD students' research ideas. Such roles lead to 'interactional asymmetries' in conversation, with some members, including the leaders themselves, having more influence on the sense-making process (Asmus and Svennevig 2009).

The last difference between the three projects is linked to the levels of knowledge and expertise that influence the form of leadership. Though the hierarchical standing of the members reflects their level of expertise, in the WSBLH and WSBNF projects the post-doctoral fellows are seen as respected members with relevant disciplinary expertise, one of the key ingredients in the DL process, in which mutual respect for disciplinary expertise is fundamental. Thus, as shown in Extracts 8.1 and 8.4, a horizontal, non-vertical context where there is no 'assigned' leader or chairperson in the meetings (Choi and Schnurr 2014) allows individual participants to enact leadership. It is also these contexts and situations that facilitate the emergence of leaders in the DL process, producing a 'blended' or 'hybrid' form of leadership (i.e. DL and traditional) that contributes to team effectiveness (Mehra et al. 2006).

Conclusion

This chapter has explored different forms of leadership exhibited in three research project meetings of one interdiscipline in order to understand the specific interactional contexts that influence the emergence of a leader in a DL process. The two key questions in understanding the DL process are *when* and *how* this form of leadership can emerge successfully in research project meetings. The findings suggest that it does not emerge because an individual with power and authority derived from that individual's standing creates a DL context in which leadership roles are controlled and distributed; rather, it is the outcome of locally situated constructions by members out of which a norm evolves in which those members who have relevant expertise emerge as leaders despite the imbalance in the distribution of power and influence both in terms of expert knowledge and standing. Thus, DL is developed organically.

The analysis of the DL (Extracts 8.1–8.4) clearly suggests that the format itself emerges entirely organically without any one individual controlling or assigning roles to members. It is those who then emerge as leaders who determine—or at the very least heavily influence—the *what*s and *how*s of a given DL pattern and its associated processes. The analysis also reveals that the question as to *when* and *how* DL patterns and processes emerge is entirely dependent on the context, though the following orientations seem to be important in the discursive construction of DL and the collaborative instantiation of power and authority:

- respect for individual members' expertise;
- receptivity to autonomy, independence and creativity;
- commitment to goal-oriented engagement;
- willingness to find common agreement on direction and to align with this.

In contexts where there are asymmetrical power relations between the chairperson or leader and members, as is the case with the WSBPR research meeting, it is much more difficult to identify DL processes. Of the three research projects we have presented in this chapter, only the WSBPR project maintained the traditional authoritative style of leadership. In the other two projects, DL processes are evident at various points during the course of a research meeting, such as *opening and closing* (see Extract 8.1), *decision-making* (see Extract 8.2) or *resolving disagreement* (Choi and Schnurr 2014). Also found is a combination of DL and authoritative leadership forms in these two research projects, emerging at different times in the life of the project (such as near the end, as in Extract 8.6) and in some cases at different points during the same meeting.

If DL is to thrive in higher education research contexts, the key to success lies in organising around the concept of a working alliance where there is agreement on direction, tasks and commitment that may or may not involve leaders and followers (Drath et al. 2008). However, our analysis has revealed that DL is less likely to develop in contexts where large teams are involved or where experiential and epistemic differences are significant, specifically where there are numbers of PhD students interacting with academic staff. These features incline the form of leadership towards a more traditional authoritative leader-follower style, which promotes asymmetrical relationships between the leader and members, reinforcing the power distance between them. If project leaders are alert to this, they will be better placed to respond to the challenge of introducing an element of DL in such contexts.

References

Antonakis, J., Cianciolo, A. T., & Sternberg, R. J. (2004). Leadership: Past, present, and future. In J. Antonakis, A. T. Cianciolo, & R. J. Sternberg (Eds.), *The nature of leadership* (pp. 3–15). Thousand Oaks: Sage.

Asmus, B., & Svennevig, J. (2009). Meeting talk: An introduction. *Journal of Business Communication, 46*(1), 3–22.

Ball, S. (2007). Leadership of academics in research. *Educational Management, Administration and Leadership, 35*(4), 449–477.

Bass, B. M. (1985). *Leadership and performance beyond expectations*. New York: Free Press.

Bass, B. M. (2008). *The Bass handbook of leadership* (4th ed.). New York: Free Press.

Baxter, J. (2010). *The language of female leadership*. Basingstoke: Palgrave MacMillan.

Bennett, N., Crawford, M., & Cartwright, M. (2003). *Effective educational leadership*. London: Paul Chapman Publishing.

Bennis, W. (1996). The leader as storyteller. *Harvard Business Review*, 74(1), 154–160.

Bolden, R. (2011). Distributed leadership in organizations: A review of theory and research. *International Journal of Management Reviews, 13*, 251–269.

Bolden, R., Petrov, G., & Gosling, J. (2008). Tensions in higher education leadership: Towards a multi-level model of leadership practice. *Higher Education Quarterly, 62*(4), 358–376.

Bolden, R., Petrov, G., & Gosling, J. (2009). Distributed leadership in higher education: Rhetoric and reality. *Educational Management Administration and Leadership, 37*(2), 257–277.

Burns, J. M. (1978). *Leadership*. New York: Harper and Row.

Choi, S., & Schnurr, S. (2014). Exploring distributed leadership: Solving disagreements and negotiating consensus in a 'leaderless' team. *Discourse Studies, 16*(1), 3–24.

Clifton, J. (2006). A conversation analytical approach to business communication. *Journal of Business Communication, 43*(3), 202–219.

Clifton, J. (2012). A discursive approach to leadership: Doing assessments and managing organizational meanings. *Journal of Business Communication, 49*, 148–168.

Clifton, J. (2015). Leaders as ventriloquists: Leader identity and influencing the communicative construction of the organisation. *Leadership*, Online. doi: 10.1177/1742715015584695

Day, D. V., Gronn, P., & Salas, E. (2004). Leadership capacity in teams. *The Leadership Quarterly, 15*, 857–880.

Drath, W. H., McCauley, C. D., Palus, C. J., Van Velsor, E., O'Connor, P. M. G., & McGuire, J. B. (2008). Direction, alignment, commitment: Toward a more integrative ontology of leadership. *Leadership Quarterly, 19*, 635–653.

Ensley, M. D., Hmieleski, K. M., & Pearce, C. L. (2006). The importance of vertical and shared leadership within new venture top management teams: Implications for the performance of startups. *Leadership Quarterly, 17*, 217–231.

Fairhurst, G. T. (2007). *Discursive leadership: In conversation with leadership psychology*. Thousand Oaks: Sage.

Fairhurst, G. T. (2009). Considering context in discursive leadership research. *Human Relations, 62*(11), 1607–1633.

Friedrich, T. L., & Mumford, M. D. (2009). The effects of conflicting information on creative thought: a source of performance improvements or decrements? *Creativity Research Journal, 21*(2–3): 265–281.

Friedrich, T. L., Griffith, J. A., & Mumford, M. D. (2016). Collective leadership behaviors: Evaluating the leader, team network, and problem situation characteristics that influence their use. *The Leadership Quarterly 27*(2), 312–333.

Gordon, R. D. (2010). Dispersed leadership: Exploring the impact of antecedent forms of power using a communicative framework. *Management Communication Quarterly, 24*, 260–287.

Gray, B. (2008). Enhancing transdisciplinary research through collaborative leadership. *American Journal of Preventive Medicine, 35*, S124–S132.

Gronn, P. (2002). Distributed leadership as a unit of analysis. *The Leadership Quarterly, 13*, 423–451.

Gronn, P. (2010). Hybrid configurations of leadership. In A. Bryman, D. Collinson, K. Grint, B. Jackson, & M. Uhl-Bien (Eds.), *Sage handbook of leadership* (pp. 435–452). London: Sage.

Hersey, P., & Blanchard, K. H. (1969). *Management of organizational behaviour*. Englewood Cliffs: Prentice-Hall.

Holmes, J., Marra, M., & Vine, B. (2011). *Leadership, discourse, and ethnicity*. Cambridge: Cambridge University Press.

House, R. J. (1971). A path–goal theory of leader effectiveness. *Administrative Science Quarterly, 16*, 321–338.

Leithwood, K., Day, C., Sammons, P., Harris, A., & Hopkins, D. (2006). *Successful school leadership: What it is and how it influences pupil learning*. Nottingham: DfES Publications.

Mailhot, C., Gagon, S., Langley, A., & Louis-Felix, B. (2016). Distributed leadership across people and objects in a collaborative research project. *Leadership, 12*(1), 53–85.

Mehra, A., Smith, B. R., Dixon, A. L., & Robertson, B. (2006). Distributed leadership in teams: The network of leadership perceptions and team performance. *Leadership Quarterly, 17*, 232–245.

Middlehurst, R., Goreham, H., & Woodfield, S. (2009). Why research leadership in higher education: Exploring contributions from the UK's leadership foundation in higher education. *Leadership, 5*, 311–328.

Mumby, D. (2001). Power and politics. In F. Jablin & L. Putnam (Eds.), *The new handbook of organizational communication: Advances in theory, research, and methods* (pp. 585–623). London: Sage.

Nielsen, M. (2009). Interpretive management in business meetings. Understanding managers' interactional strategies through conversation analysis. *Journal of Business Communication, 46*, 23–56.

Northouse, P. G. (2004). *Leadership: Theory and practice* (3rd ed.). Thousand Oaks: Sage.

Pearce, C., & Conger, J. A. (2003). *Shared leadership: Reframing the hows and whys of leadership*. London: Sage.

Pearce, C. L., & Sims Jr., H. P. (2002). Vertical versus shared leadership as predictors of the effectiveness of change management teams: An examination of aversive, directive, transactional, transformational and empowering leader behaviors. *Group Dynamics, 6*, 172–197.

Rost, J. (1991). *Leadership for the twenty-first century*. New York: Praeger.

Schnurr, S., & Chan, A. (2011). Exploring another side of co-leadership: Negotiating professional identities through face-work in disagreements. *Language in Society, 40*(2), 187–210.

Svennevig, J. (2008). Exploring leadership conversations. *Management Communication Quarterly, 21*, 529–536.

Tourish, D. (2007). Communication, discourse and leadership. *Human Relations, 60*(11), 1727–1740.

Uhl-Bien, M. (2006). Relational leadership theory: Exploring the social processes of leadership and organizing. *Leadership Quarterly, 17*, 654–676.

Uhl-Bien, M., Marion, R., & McKelvey, B. (2007). Complexity leadership theory: Shifting leadership from the industrial age to the knowledge era. *Leadership Quarterly, 18*, 298–318.

Wodak, R., Kwon, W., & Clark, I. (2011). Getting people on board: Discursive leadership for consensus building in team meetings. *Discourse and Society, 22*(5), 592–644.

Yammarino, F. J., Salas, E., Serban, A., Shirreffs, K., & Shuffler, M. L. (2012). Collectivistic leadership approaches: Putting the "we" in leadership science and practice. *Industrial and Organizational Psychology, 5*, 382–402.

9

Conclusion

A Strange Familiarity

From the outset we have treated interdisciplinarity as something distinctive, a feature of the academic landscape with characteristics that set it apart from the more traditional context from which it has grown; we have also noted that for some writers it represents a challenge to that context, pointing to a future in which conventional structures and hierarchies are reconfigured and ways of approaching research are radically revised. Yet we have also argued that hard research into the nature of interdisciplinarity is currently far too limited to allow anything like the depth of understanding necessary to support confident claims about its workings. The field is rich in experiential accounts, theorised representations, typological analyses and practical recommendations, but with relatively few exceptions treatments of how such research actually gets done remain as neglected now as they did in 2005 when Klein drew attention to the problem. As interdisciplinary research gathers momentum and plays an increasingly important role on the academic stage, the consequences of this neglect become potentially more serious and the need for investigation more pressing.

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In view of the work that still needs to be done in order to establish the foundations for understanding the nature of interdisciplinarity, the findings of this book can do no more than represent a selective scratching of an extensive surface, but in this conclusion we hope to show that they have revealed some potentially very interesting depths. More importantly, they have identified aspects of interdisciplinary research engagement that can be used to inform work by those involved in the preparation and development of interdisciplinary researchers, and this too will feature in the chapter.

When a development is relatively new, demonstrably successful and ripe with promise—and especially when it is seen by some as having transformative potential—it is natural to see it in terms of what makes it distinctively different rather than considering how far its practices reflect more conventional approaches. As a preface to the chapter, therefore, we consider briefly how interdisciplinary work fits within the broader context of academic research, a theme that will be taken up as the findings of our own research are considered.

Groups of people working or living together will develop their own ways of doing things that make each group interactionally unique but at the same time make invisible to participants aspects of both their behaviour and that of their fellow members. This was strikingly illustrated by Garfinkel (1984: 44–47) in his report on undergraduate students asked to spend between 15 minutes and an hour in their homes viewing the activities there as though they were boarders, a perspective that most found difficult to sustain. The 'seen but unnoticed' background within which common understandings are set means that actions that appear as perfectly normal to participants may strike outsiders as strange, which is why reports by members on the nature of engagement within a particular group are inevitably incomplete and may well be misleading. Yet when the interaction is examined closely and compared with that of similar groups, features of the talk and sequences within it emerge as common to particular groups or professions, making it possible to identify interactional characteristics associated with these. The most striking examples of this are to be found in contexts where very strict rules apply to what is interactionally acceptable. In courtroom cross-examinations, for example, the floor is controlled by the barrister, who directs a series of questions to the person on the witness stand, who in turn is required to respond truthfully to these questions, confining their response to what is directly relevant. Barristers may also design their questions not to *elicit* information for themselves but to *display* it for the benefit of the jury, which produces lines of questioning that in a medical consultation or a police interrogation, for example, would seem grossly inefficient.

With this perspective in mind, it is important to remember that interdisciplinary research is primarily an *academic* activity and that the norms that govern academic research engagement in general will apply equally well here. Researchers engaging in interdisciplinary research display a range of behaviours that will be familiar to all those with experience of academic research and bring with them expectations that are for the most part shared with those of other participants. However, there will also be features that are distinctive, either because they are characteristic of interdisciplinary engagement in general or because they have developed as idiosyncratic features as the result of numerous encounters involving the same people over a prolonged period. It is the former that are particularly relevant if the purpose of understanding is to improve practice. An excellent illustration of this is to be found in Heritage and Maynard's (2006: 364) example of how the investigation of doctor-patient interaction revealed that the two parties handle the management of diagnosis and treatment discussions in 'sequentially distinctive ways'.

In a seminal introduction to work on institutional interaction, Drew and Heritage (1992: 22) proposed three features that are characteristic of institutional interaction: that it is normally informed by goal orientations conventionally associated with the relevant institution, that it involves particular constraints on what participants will treat as allowable contributions to the business being conducted, and that it may be associated with particular inferential frameworks. The first is common to both interdisciplinary and disciplinary research, which share the goal of achieving a successful research outcome, while the second is also largely shared. The research meetings in our data set, for example, tend to follow a standard format that begins with social chat, moves onto research business and ends with arrangements for the next meeting or next phase of the research, each stage marked by what count as acceptable topics and ways of talking about them. However, there may be conventional differences between disciplines in terms of how particular interactional ends are accomplished, as in Strober's example of a 'flare up' (see Chap. 5), where different views of what was allowable in terms of challenging a position led to a participant leaving the group. Such differences are likely to be confined to initial meetings and are unlikely to represent a continuing challenge, but Drew and Heritage's third element, inferential frameworks, is likely to be more problematic because orientation here is more likely to be to the discipline than to the institution, and the frameworks associated with one discipline may not carry over to another. This may go some way to explaining why so much time in initial meetings tends to be invested in clearing conceptual ground.

In what follows we discuss the key findings that have emerged from this book, setting them in the context of previous work on interdisciplinary research and where appropriate relating them to the broader academic context. The chapter has two aims: to identify those areas where conventional views of the nature of interdisciplinary research may need to be revised or at least investigated further, and to consider whether the current findings have any implications for the training and/or support of interdisciplinary researchers. It begins with a consideration of a topic that is fundamental to such research.

Disciplinary Difference

The most obvious and oft-mentioned difference between research within a single discipline and interdisciplinary research is the fact that the latter depends on representatives of different disciplines working together. A conclusion that often seems to be derived from this is that the greatest challenges in interdisciplinarity must therefore lie in disciplinary difference as such, rather than in factors arising from relationships associated with this. One of the outcomes of the research presented in this book is that such a conclusion may be unwarranted and that a focus on *disciplinary* differences may distract attention from other differences that are more salient.

Although disciplinary differences were apparent in the climate and security meeting, for example, they were expressed more broadly in terms of the division between social scientists and physical scientists rather than in terms of disciplinary distinctions, hence the call for 'the scientists who are here could tell us maybe what they think is missing' (Evan, CS4/5090429-01:30:04) or Mike's self-reference as one of the 'softies' (CS4/5090429-01:33:50). More importantly, they were not the source of fundamental disagreement or misunderstanding, serving instead (as in the history meeting) as points of reference. The distinction that led to the most heated disagreement and that exposed fundamental divisions in terms of perspective and approach was that between those for whom theory was an essential foundation for bringing about change and those who saw it as a form of ivory tower separation from real-world concerns, a position that was represented most pungently in Rachel's reference to 'our responsibility as academics is to try and come up with some policy making solutions rather than sit around inventing poxy concepts' (CS3/4090429-01:11:45).

There are at least some grounds for thinking that this division between theoretically oriented researchers and those working out of practice is not confined to this particular meeting because not only the debate itself but also the intensity with which it was pursued also feature in an exchange between researchers in the same field, that of human rights. The two academics involved are both senior figures in their field, well known to each other and in this case participating in a seminar on the subject of global justice. The following brief extracts provide a flavour of the exchange between them (Richards 2009). The first is from the opening presentation given by a speaker whose orientation is avowedly theoretical and the second is the concluding comment from the second speaker, who in her presentation has attacked the theoretical detachment of the first speaker. The final extract is taken from the first speaker's response to this in the discussion that follows all the presentations:

> So you can see what I call a political theology, the term is of course from Karl Schmidt, from 1929, but you can see and Karl Schmidt by the argument that all the- the powers of the state, all the organisation of the state, were secularised versions of theology.

> And I suppose I get impatient with the high powered [turns to first speaker and addresses next two words to him, smiling] meta discourse, [turns back to audience] of how we deal with globalisation.

> Sometimes we resort to a more theorising discourse because we need theory. Activists need theory. In fact we are heading to a new period in which we are still probably some of the people, still of the old generation in which we make these distinctions between intellectuals and activists. That doesn't hold any more, in my view. In fact most of us that work both with social movements and we do theorise and I see people here on this panel doing precisely that.

Despite the conciliatory tone of the final extract, it is worth noting that the second speaker began her presentation by thanking the chair for introducing her 'using words I could understand', provoking laughter from the audience at the expense of the first speaker, whose presentation could be described as both conceptually and lexically demanding.

Both of these examples are taken from the social sciences and cannot be adduced as evidence that this theory/practice division is widespread, but they do suggest that it is not confined to interdisciplinary engagement. They also need to be seen in a wider academic context where in some disciplinary areas—and possibly more generally—there is an implicit hierarchy in which researchers working on theoretical problems have more kudos than those engaged in practical experimentation or application. Increasing emphasis on the importance of the impact of research outside the academy might serve to shift the balance here, but this too is part of a wider picture. More broadly still, it could be argued that the opposition of theory and practice is fundamental to the relationship between science and society itself, as reflected in Feyerabend's conclusion to his discussion of the relationship between democracy and scientific method: 'What counts are not intellectual schemes, but the wishes of those who want change. Or, to use a catchy slogan: *citizens' initiatives instead of philosophy!*' (1999: 226, italics as in original).

None of this calls into question the necessity of recognising the importance of different disciplinary orientations in interdisciplinary research or the challenges that might arise from these, but it does underline the importance of not allowing this recognition to distract attention from other, possibly more important, features of interdisciplinary engagement. Disciplinary differences should be seen as part of a wider and more complex picture in which different forces are at work, all with the potential to affect the forms of engagement in play in any interdisciplinary situation. Indeed, academics are all too familiar with—and usually sensitive to—disciplinary difference so it might be argued that in practical terms more is to be gained from preparing them for other differences and divisions rather than reinforcing expectations that may then become self-fulfilling.

The perceptions of those engaged in interdisciplinary research are of course important, but we have argued that too much reliance has thus far been placed on them as sources of information about what actually happens in interdisciplinary engagement. Our initial arguments were methodological, highlighting an imbalance in the sort of research that has been undertaken and pointing out the failure to give due attention to developments that have taken place in the collection and use of interview data, but they were borne out at least to some extent by our findings. There was no evidence whatsoever in our data set of any problems, misunderstandings or disagreements arising from terminological differences; in fact, on the only occasion when attention was drawn to terminology it was for the purpose of raising a laugh at the expense of a colleague from another discipline whose prior turn had been peppered with jargon. The same was not true of conceptual engagement, especially in initial meetings, where one of the stated aims was to discuss key terms and considerable interactional effort was invested in clarifying conceptual positions associated with these. In the light of this, we suggested that perhaps in interviews respondents represent these conceptual differences as a matter of terminology—which in one sense they are.

The problem of representing the main challenge in interdisciplinary engagement as one of terminology is not merely that it is inaccurate and directs attention away from more important concerns, but that it holds out the prospect of a solution that is appealingly straightforward and relatively simple, when the reality is much more complex and considerably more demanding. For participants and especially for leaders, advice on how to engage productively with conceptual issues, especially in early meetings, is likely to pay richer dividends.

Interdisciplinary Difference

As Chap. 3 showed, fundamental distinctions between multidisciplinary, interdisciplinary and transdisciplinary research are now generally recognised, though finer points of definition and usage are still a matter for healthy debate. Work on constructing typologies of interdisciplinarity is also well established and there is available a model of stages in the development of an interdisciplinary project. This represents a rich and important fund of work on the nature of interdisciplinarity and though we have taken up a clear position on some issues, we would not wish to call into question the value of the work that has already been done. However, the findings in this book do suggest that more attention might be given to the distinction between interdisciplinary research in the form of projects and that which takes place within interdisciplines. To argue that differences between the two are merely a reflection of the difference between interdisciplinary and transdisciplinary research would fail to do justice to the very important identity issues that influence interaction in interdisciplines. In what follows we take up this theme as part of an argument for paying more attention to the nature of interdisciplinary work within interdisciplines, using systems biology as our example.

An obvious and relatively trivial difference between interdisciplinary research, in which researchers from different disciplines are brought together for the purpose of completing a particular project, and what we have called interdiscipline research, where the different disciplines involved fall under the umbrella of a specific academic designation, is that the model for stages in the former does not seem to apply to the latter. As the analysis in Chap. 5 revealed, the interdisciplinary meetings in this study broadly followed Stage 1 of Amey and Brown's (2005) model: single-discipline oriented and characterised by information exchange rather than integration. In addition there was clear evidence of competition in one of the two meetings studied, which also supported Amey and Brown's conclusions. Interactionally, initial interdisciplinary meetings were marked by distinctively long turns, usually attracting little by way of minimal feedback from participants (though the size of the meetings might have been a factor here), and in this respect they were markedly different from the interdiscipline meeting, where turns were much shorter, feedback was frequent and positions were collaboratively constructed in a way more characteristic of the final stage of Amey and Brown's model. There is a straightforward explanation for this: while most of the participants meeting for the first time in interdisciplinary projects will be unfamiliar with one another and, to a very large extent, with the conceptual substrata of other disciplines, researchers within an interdiscipline will be well acquainted with the other disciplines involved, will have worked with their representatives and may well be acquainted, either directly or indirectly, with the other researchers at the meeting. This renders redundant the sort of conceptual groundwork that seems to be an essential foundation for interdisciplinary research and allows a much more practical focus on issues of method and procedure. As the analysis in Chap. 5 showed, this is precisely what the interaction reflects.

In fact, more is at stake in the distinction between interdiscipline research and interdisciplinary research than the application of a descriptive model because the factors that make an interdiscipline distinctive also contribute to aspects of engagement that may influence the success or otherwise of an interdiscipline project. In our study the collaborative orientation of research teams in systems biology was demonstrable, participants working together to construct shared understanding and develop common positions. The data revealed that so-prefaced turns were particularly prominent in this, allowing those involved gradually to reduce the epistemic gradient between them and researchers from other disciplines, in some sequences of talk using so-prefaced turns to establish the foundation for a proposal or suggestion. We were also able to reveal different forms of leadership in play, some of them perhaps possible only within an interdiscipline, where academic and epistemic status in the field is recognised by those present. This is a situation that does not obtain in interdisciplinary research, where prestige in one discipline usually does not carry over into another.

However, the research also revealed differences within systems biology that were not conducive to fully productive engagement. It was clear that the precedence of biology noted by other researchers was reflected in the interactional dominance of wets at the expense of dries. The existence of these two groups is a fact of systems biology, and the interdiscipline depends on their working together collaboratively. On the surface this was the case with our groups, but in some of them dries were not always allowed the opportunity to develop their points fully. It is interesting to note that this imbalance was most noticeable in the WSBLH project, and it was this project that in the eyes of those contributing to it was least successful; some, in fact, regarded it as a failure. A number of factors will surely have contributed to this, and we did not probe the nature of the perceived failure, but the extent of asymmetry in wet/dry interactional rights in the project is at least worth noting. In fact, its more general presence in our data suggests that it would merit further investigation in the context of systems biology generally.

There is in fact a solid literature on the structure, challenges and research potential of systems biology, some of it in the form of overviews (e.g. Kitano 2002, Aderem 2005, Friboulet and Thomas 2005, O'Malley and Dupré 2005), some more extensive (e.g. Kitano 2001), but very little attention has been directed to the discourses through which it is constructed and even here access is via interviews rather than direct analysis of the discourse itself (e.g. Calvert and Fujimura 2011). A deeper familiarity with interactional engagement in interdisciplines is important if we are to understand better what contributes to success or failure in interdiscipline research. It would provide insights, for example, into the way power differentials are negotiated or exploited. The potential impact of power differences was suggested by Frescoln and Arbuckle (2015) as a possible reason why, in their evaluative survey over time of a large transdisciplinary project, principle investigators and members of advisory boards grew more positive in their attitudes as the project progressed, but this was not the case with graduate students.

At this point it is necessary to introduce a caveat because although some features will be relevant to interdisciplines generally, the focus on systems biology in this book should not be treated as representative. One of the most illuminating developments in studies of the academic world over the past half-century has been recognition of the profound differences that exist between disciplines and there is no reason to assume that this will not carry over to interdisciplines. Knorr Cetina, for example, compares the 'individual, bodily, lab-bench science' of molecular biology, a discipline closely related to systems biology, with 'the communitarian science of physics' (1999: 4), contrasting the 'territorial regimes' of the former with the 'temporal monopolies' of high energy physics (1999: 240). Where cultural norms and practices are as different as this, it is dangerous to take any single (inter)discipline as representative.

Some Implications for Practice

Ultimately, the value of the research in this book will be determined by the extent to which is it able to contribute to more effective interdisciplinary research. Given its preliminary nature any recommendations with respect to this must necessarily be tentative at this stage, though the next section suggests ways in which research in this area might be extended, providing a more confident foundation for the development of targeted support for interdisciplinary research. In what follows, however, we identify what we take to be important practical considerations arising from our research in the hope that these will contribute to more informed decisions on training and support.

There are two respects in which our research can provide very clear guidance on the advice and help provided to interdisciplinary researchers. The first is that it is inadvisable to place too much emphasis on terminological challenges in this context. While terminological differences or lacunae might emerge in such research and participants should be made aware of this, if time is available for training this would be better invested in addressing the much more complex issue of conceptual differences. It can be pointed out that what may be presented as a definitional matter can quickly develop into conflict between deeply held views arising from sometimes subtle conceptual differences. Ways of negotiating this without undermining a commitment to shared progress need to be found, and strategies for achieving this can be discussed. As in so many things, raising awareness of how and why differences emerge can reduce the likelihood of positions becoming entrenched and progress hindered.

It is natural to assume that where there is disciplinary difference this will be the source of most of the disagreement that arises—especially where this disagreement is deep. However, this can result in a misunderstanding of what needs to be done in order to find an effective resolution, so researchers need to be made aware that other factors may come into play, calling for different responses. The example of the theory/practice division in the climate and security meeting provides an example of this and also serves as a good illustration of a difference that is as evident within disciplines as it is between them. In fact, it may be useful when discussing differences to follow Knorr Cetina's (1999) recommendation and think in terms of epistemic cultures rather than disciplines.

The second aspect of our research that can serve as the basis for practical advice is in its distinction between interdisciplinary and interdiscipline research. The advice on clearing conceptual ground, for example, is important where interdisciplinary research is concerned but redundant in interdisciplines. This suggests that wherever possible researchers within an interdiscipline should be grouped separately in training contexts from those involved in interdisciplinary projects so that the advice given to them is appropriate to their specific needs and not either irrelevant or misleading. Where groups are mixed, important differences between the two situations should be made clear and perhaps used as the basis for discussion.

The nature of epistemic asymmetry and its negotiation should feature in training, with participants introduced to the basic aspects of Heritage's work such as the notion of an epistemic gradient and the concepts of epistemic stance and epistemic status. These are not designed as a recipe for the successful negotiation of epistemic asymmetry but as descriptive terms serving to illuminate the process of adjustment that takes place when asymmetries exist, and they should be presented as such. Familiarity with features that are being used naturally and without awareness does not impinge on practice, but where problems arise it serves to direct attention to possible sources of these and provides a vocabulary for explaining how they might be resolved. In the case of interdiscipline research particularly, but also potentially in interdisciplinary research, participants should also be alerted to the dangers of impoverishing the contributions of one or more disciplines within a team by a dominant group exploiting epistemological asymmetries, as in the case of wets and dries in systems biology.

One way of avoiding such outcomes is through effective leadership, and here too the research in this book might have a part to play. Research on leadership is already extensive and offers a rich fund of advice for the preparation of leaders, but there are nevertheless aspects of interaction in the leadership of interdiscipline research teams that this book has revealed, such as the use of upshots and displays of non-understanding, that might prove a useful if minor addition to standard advice. It has also shown the very different approaches to leadership that are evident in this context and identified some of the factors that tend to promote the emergence of distributed leadership.

Resources that could be used in the design of materials to support these points are currently in short supply, though extracts in this book would serve to illustrate important features of interdisciplinary interaction. There are examples here, amongst other things, of different leadership styles, of how collaborative positions are constructed, how conceptual differences can lead to potentially insulting exchanges, how epistemic asymmetries are negotiated and how these might serve in some cases to exclude some groups from full participation without this ever being made explicit. If these materials can be supplemented by extracts from exchanges involving participants themselves, the impact can be even more powerful. As applied linguists know, academics from all fields are interested in how they get things done and when recordings are made they are usually keen to discover what the researcher has noticed about their own interaction. This can be exploited in training. If a participant can be encouraged to record (with permission and with all the usual safeguards in place) an interdisciplinary meeting in which they are involved, all they need to do is note the exact time recording begins and if interesting exchanges (misunderstandings, arguments, successful negotiations, etc.) take place note down the time. It is then a relatively small matter to identify the extract in the recording, noting where it begins and ends. This can then be shared with the trainer or mentor who can play the relevant passage to the individual or group, ideally with an accompanying transcript, in order to discuss what has happened and what might be learned from this.

This section has done no more than indicate the sort of training and development work, based on interaction, that might be done in order to support interdisciplinary research. A more detailed specification would not take account of local needs and practices and a fuller account would need to draw on a more extensive resource bank than is available in this book. Nevertheless, we believe that the suggestions here provide clear pointers to more fully articulated programmes.

Conclusion: Deepening Understanding

As we have already insisted, the work in this book is preliminary; its value, we believe, lies in the extent to which it points the way to a greater understanding of the ways in which interdisciplinary research gets done. Within the relatively limited scope of our research, focusing as it does only on spoken interaction and ignoring written discourse or the broader ethnographic context in which the interaction is situated, we have ranged as widely as our tools have allowed, embracing broader features of the interaction such as the ways in which understanding is collaboratively constructed or leadership enacted, and specific details down to the level of the individual discourse marker. If any firm conclusion can be drawn from this it is that the analysis of interaction can reveal aspects of interdisciplinary research engagement that remain hidden behind post hoc participant impressions.

It is beyond question that research of this kind is needed. In their overview of the 'science of team science' Stokols et al. (2010) identify the methods used, both qualitative (appreciative inquiry, interviews, self-directed qualitative discussions, document review of narrative accounts and external review) and quantitative (standardised surveys, ratings of written products, financial analyses, social network analyses and bibliometric analysis), but none of them examines *directly* what actually happens in such research. Widely acknowledged as likely to make an invaluable contribution to life in the twenty-first century, interdisciplinary research remains a subject that is nevertheless studied at one remove. As long as this persists we will not be in a position to claim that we understand to any reasonable extent how it gets done in practice and therefore will not be able to direct training and development in an informed way.

Perhaps the most serious drawback in researching interaction is that it is very time-consuming and the development of adequate databases is a slow process. It is also clear from the findings of this book that there are fundamental differences between interdiscipline research and interdisciplinary research, as well as more local variations, so the territory to be covered is extensive. Nevertheless, it should be possible over time to extend the range of interactional contexts covered and our understanding will be enriched if this research can be linked to ethnographic studies, either in complementary projects or integrated within linguistic ethnography. There are also opportunities for interdisciplinary projects bringing together interactional and psychological research, where there is already an interesting body of work on interdisciplinary groups, or for this work to be undertaken within discursive psychology. This would respond to Heimeriks' (2013) call to study interdisciplinarity more broadly than is currently the case since it is embedded within a larger knowledge system—and, it should be added, cultural context.

It is a commonplace in the academic world that researchers should indicate how their work might be taken forward, but in this case we would wish to emphasise that we do not see the above work as an extension of our own. There is so much territory to be explored in the area of interdisciplinary engagement and so many ways of investigating this that our plea is rather for a significant broadening of research approaches, albeit one in which interactional research would feature prominently. This represents an investment in our future because if we can understand better how interdisciplinary research gets done, we can find ways of doing it better, and in doing it better we can enhance its contribution to the world in which we live. We end therefore with a reminder of the National Academies conclusion that communication is at the heart of interdisciplinary research and with a plea that the implications of this should be heeded.

References

Aderem, A. (2005). Systems biology: Its practice and challenges. *Cell, 121*, 511–513.

Amey, M. J., & Brown, D. F. (2005). Interdisciplinary collaboration and academic work: A case study of a university partnership. *New Directions for Teaching and Learning, 102*, 23–35.

Calvert, J., & Fujimura, J. H. (2011). Calculating life? Duelling discourses in interdisciplinary systems biology. *Studies in History and Philosophy of Biological and Biomedical Sciences, 42*, 155–163.

Drew, P., & Heritage, J. (1992). Introduction. In P. Drew & J. Heritage (Eds.), *Talk at work* (pp. 3–65). Cambridge: Cambridge University Press.

Feyeraband, P. K. (1999). Democracy, élitism, and scientific method. In J. Preston (Ed.), *Paul K. Feyeraband: Knowledge, science and relativism. Philosophical*

Papers Volume 3 (pp. 212–226). Cambridge: Cambridge University Press. (Reprinted from Feyeraband, P. K. (1980). Democracy, élitism, and scientific method. *Inquiry*, *23*: 3–18).

Frescoln, L. M., & Arbuckle Jr., J. G. (2015). Changes in perceptions of transdisciplinary science over time. *Futures, 73*, 136–150.

Friboulet, A., & Thomas, D. (2005). Systems biology – An interdisciplinary approach. *Biosensors and Bioelectronics, 20*, 2404–2407.

Garfinkel, H. (1984). *Studies in ethnomethodology*. Cambridge: Polity Press.

Heimeriks, G. (2013). Interdisciplinarity in biotechnology, genomics, nanotechnology. *Science and Public Policy*, *40*(1), 97–112.

Heritage, J., & Maynard, D. W. (2006). Problems and prospects in the study of physician-patient interaction: 30 years of research. *Annual Review of Sociology, 32*, 351–374.

Kitano, H. (Ed.). (2001). *Foundations of systems biology*. Cambridge, MA: The MIT Press.

Kitano, H. (2002). Systems biology: A brief overview. *Science, 295*, 1662–1664.

Knorr Cetina, K. (1999). *Epistemic cultures: How the scientists make knowledge*. Cambridge, MA: Harvard University Press.

O'Malley, M. A., & Dupré, J. (2005). Fundamental issues in systems biology. *BioEssays, 27*, 1270–1276.

Richards, K. (2009). A hard act to follow: Conference debate and student argument. In M. Gotti (Ed.), *Commonality and individuality in English academic discourse* (pp. 83–113). Bern: Peter Lang.

Stokols, D., Hall, K. L., Moser, R. P., Feng, A., Misra, S., & Taylor, B. K. (2010). Cross-disciplinary team science initiatives: Research, training and translation. In R. Frodeman, J. T. Klein, C. Mitcham, & J. B. Holbrook (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 471–493). Oxford: Oxford University Press.

Appendix: Transcription Systems and Analytical Note

Detailed Transcripts

The system used is based on Jefferson (1989: 193–6). Text appears in Courier New.

.	Falling intonation	That was foolish.
,	Continuing contour	I took bread, butter, and jam
?	Questioning intonation	Who was that?
!	Exclamatory utterance	Look!
(2.0)	Pause of about 2 seconds	So (2.0) where are we going?
(0.2)	Pause of 0.2 of a second	It was (0.4) Friday.
┌ ┐ └ ┘	Overlapping talk	A: He saw ┌it┐ and stopped B: └oh┘
┌┌ └└	Speakers start at same time	┌┌A: And the- └└B: So she left it behind.
=	Latched utterances	A: We saw her yesterday.= B: =And she looked fine.
=	Turn continues after overlap	A: You ┌ought┐ to check with= B: └What!┘ A: =the plumber first.
______	Emphasis	Put it away.
:	Sound stretching	We waited for a lo:::ng time

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(xxx)	Unable to transcribe	We'll just (xxxx xxx) it.
(word)	Unsure transcription	And then he (juggled) it
(( ))	Other details	Leave it alone((moves book))
↑	Prominent rising intonation	It was ↑wonderful
↓	Prominent falling intonation	That's the end of ↓that
-	Abrupt cut-off	If you go- if you leave
(x)	Hitch or stutter	I (x) I did
CAPS	Louder than surrounding talk	It's BILL I think
hhh	Aspirations	That's hhhhh I dunno
·hhh	Inhalations	·hhhh well I suppose so
(h)	Breathiness (e.g laughing, crying)	So we w(h)e(h)nt
° °	Quieter than surrounding talk	Let him see it °why don't you°
> <	Quicker than surrounding talk	>I'd just< leave it there.
< >	slower than surrounding talk	<Leave it alone> and just go.

Basic Transcripts

This uses a more limited range of the above features. Text appears in the same font as the main text.

.	Falling intonation	That was foolish.
,	Continuing contour	I took bread, butter, and jam
?	Questioning intonation	Who was that?
…	Pause of less than a second	It was … Friday.
__	Emphasis	Put it away.
-	abrupt cut-off	If you go- if you leave
[ ]	Overlapping talk	A: He saw [it] and stopped
[ ]		B: [oh]
=	Turn continues after overlap	A: You [ought] to check with= B: [What!] A: =the plumber first.
(xxx)	Unable to transcribe	We'll just (xxxx xxx) it.
(word)	Unsure transcription	And then he (juggled) it
(( ))	Other details	Leave it alone ((moves book))
[…]	Text omitted	A: And that was that. […] B: We did something similar

[*italics*]	Words missing from the recording but included for clarity	It's on the top [of] it.

Analytical Note

Diagrams are based on the analysis of an extensive data set based on the application of predetermined labels. The scope and focus of the findings are therefore subject to the nature of the labels, which in turn reflect researcher positioning. The results of the analysis should be treated as indicative, serving as a valuable basis for further more detailed investigation of the construction of the talk itself.

Detailed analysis follows conversation analysis in treating the talk as the only legitimate evidential resource, avoiding recourse to extraneous features (e.g. derived from theory or context) for explanatory purposes. The font used to mark extracts subject to this analysis is Courier New.

More general analysis, based only on what is grossly apparent, appears in ordinary font and is represented by a basic transcription system. The data presented is not analysed in detail but has been selected to represent a feature of the talk that has been identified as part of a more general analysis. Where quantitative claims are made, these are restricted to only those features that emerge very clearly from the analysis or are immediately obvious (e.g. that longer turns are a characteristic feature of one meeting but are overwhelmingly less present in another). The basis for claims here is that they are 'grossly apparent'.

References

Abbott, A. (2001). *Chaos of disciplines*. Chicago: University of Chicago Press.

Aboelela, S. W., Larson, E., Bakken, S., Carrasquillo, O., Formicola, A., Glied, S. A., Haas, J., & Gebbie, K. M. (2007). Defining interdisciplinary research: Conclusions from a critical review of the literature. *Health Services Research, 42*(1 Part I), 329–346.

Aderem, A. (2005). Systems biology: Its practice and challenges. *Cell, 121*, 511–513.

Agrawal, A. (1999). New institute to study systems biology. *Nature Biotechnology, 17*, 743–744.

Aijmer, K. (2013). *Understanding pragmatic markers: A variational pragmatic approach*. Edinburgh: Edinburgh University Press.

Aijmer, K., & Stenström, A.-B. (2006). Approaches to spoken interaction. *Journal of Pragmatics, 37*, 1743–1751.

Akkerman, S. F., & Bakker, A. (2011). Boundary crossing and boundary objects. *Review of Educational Research, 81*(2), 132–169.

Akkerman, S., Admiraal, W., Simons, R. J., & Niessen, T. (2006). Considering diversity: Multivoicedness in international academic collaboration. *Culture & Psychology, 12*(4), 461–485.

Aldrich, J. H. (2014). *Interdisciplinarity*. Oxford: Oxford University Press.

S. Choi, K. Richards, *Interdisciplinary Discourse*,
DOI 10.1057/978-1-137-47040-9

Amey, M. J., & Brown, D. F. (2005). Interdisciplinary collaboration and academic work: A case study of a university partnership. *New Directions for Teaching and Learning, 102*, 23–35.

Anderson, H. (2013). The second essential tension: On tradition and innovation in interdisciplinary research. *Topoi, 32*(1), 3–8.

Antaki, C. (2008). Discourse analysis and conversation analysis. In P. Alasuutari, L. Bickman, & J. Brannan (Eds.), *The Sage handbook of social research methods* (pp. 431–446). London: Sage.

Antonakis, J., Cianciolo, A. T., & Sternberg, R. J. (2004). Leadership: Past, present, and future. In J. Antonakis, A. T. Cianciolo, & R. J. Sternberg (Eds.), *The nature of leadership* (pp. 3–15). Thousand Oaks: Sage.

Aram, J. (2004). Concepts of interdisciplinarity: Configurations of knowledge and action. *Human Relations, 57*(4), 381.

Asmus, B., & Svennevig, J. (2009). Meeting talk: An introduction. *Journal of Business Communication, 46*(1), 3–22.

Baker, M. (1988). Sub-technical vocabulary and the ESP teacher: An analysis of some rhetorical items in medical journal articles. *Reading in a Foreign Language, 4*(2), 91–105.

Ball, S. (2007). Leadership of academics in research. *Educational Management, Administration and Leadership, 35*(4), 449–477.

Bammer, G. (2013). *Disciplining interdisciplinarity: Integration and implementation sciences for researching complex real-world problems*. Canberra: Australian National University E Press.

Barry, A., & Born, G. (2013). Interdisciplinarity: Reconfigurations of the social and natural sciences. In A. Barry & G. Born (Eds.), *Interdisciplinarity: Reconfigurations of the social and natural sciences* (pp. 1–56). Oxford: Routledge.

Barry, A., Born, G., & Weszkalnys, G. (2008). Logics of interdisciplinarity. *Economy and Society, 37*(1), 20–49.

Bass, B. M. (1985). *Leadership and performance beyond expectations*. New York: Free Press.

Bass, B. M. (2008). *The Bass handbook of leadership* (4th ed.). New York: Free Press.

Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership* (2nd ed.). Mahwah: Lawrence Erlbaum.

Bauer, H. H. (1990). Barriers against interdisciplinarity: Implications for studies of science, technology, and society (STS). *Science, Technology, and Human Values, 15*, 105–119.

Baxter, J. (2010). *The language of female leadership*. Basingstoke: Palgrave MacMillan.

Becher, T. (1981). Towards a definition of disciplinary cultures. *Studies in Higher Education, 6*(2), 109–122.

Becher, T. (1989). *Academic tribes and territories: Intellectual enquiry and the cultures of disciplines*. Milton Keynes: Open University Press.

Becher, T., & Trowler, P. (2001). *Academic tribes and territories: Intellectual enquiry and the culture of disciplines* (2nd ed.). Buckingham: Open University Press/SRHE.

Beers, P. J. & Bots, P. W. G. (2007). Eliciting conceptual models to support interdisciplinary research. Proceedings of the 40th Hawaii international conference on system sciences, 2007. IEEE.

Belcher, B. M., Rasmussen, K. E., Kemshaw, M. R., & Zornes, D. A. (2016). Defining and assessing research quality in a transdisciplinary context. *Research Evaluation, 25*, 1–17.

Bennett, J. B. (1988). Power and influence as distinct personality traits: Development and validation of a psychometric measure. *Journal of Research in Personality, 22*, 361–394.

Bennett, N., Crawford, M., & Cartwright, M. (2003). *Effective educational leadership*. London: Paul Chapman Publishing.

Benwell, B., & Stokoe, E. (2006). *Discourse and identity*. Edinburgh: Edinburgh University Press.

Berger, G. G. (1972). Opinions and facts. In L. Apostel, G. Berger, A. Briggs, & G. Michaud (Eds.), *Interdisciplinarity: Problems of teaching and research in universities* (pp. 21–74). Paris: Organization for Economic Cooperation and Development.

Biber, D., Conrad, S., Reppen, R., Byrd, P., & Helt, M. (2002). Speaking and writing in the university: A multidimensional comparison. *TESOL Quarterly, 36*(1), 9–43.

Birnbaum, P. H. (1977). Assessment of alternative management forms in interdisciplinary projects. *Management Science, 24*(3), 272–284.

Blackmore, P., & Kandiko, C. B. (2011). Interdisciplinarity within an academic career. *Research in Post-Compulsory Education, 16*(1), 123–134.

Blakemore, D. (1988). So as a constraint on relevance. In R. M. Kempson (Ed.), *Mental representations: The interface between language and reality* (pp. 183–195). Cambridge: Cambridge University Press.

Blakemore, D. (2004). Discourse markers. In L. R. Horn & G. Ward (Eds.), *The handbook of pragmatics* (pp. 222–240). Oxford: Blackwood.

Boix Mansilla, V. (2005). Assessing student work at disciplinary crossroads. *Change: The Magazine of Higher Learning, 37*(1), 14–21.

Bolden, G. B. (2006). Little words that matter: Discourse markers 'so' and 'oh' and the doing of other-attentiveness in social interaction. *Journal of Communication, 56*, 661–688.

Bolden, G. B. (2008). 'So what's up?': Using the discourse marker *so* to launch conversational business. *Research on Language and Social Interaction, 41*(3), 302–337.

Bolden, G. B. (2009). Implementing incipient actions: The discourse marker 'so' in English conversation. *Journal of Pragmatics, 41*(5), 974–998.

Bolden, R. (2011). Distributed leadership in organizations: A review of theory and research. *International Journal of Management Reviews, 13*, 251–269.

Bolden, R., Petrov, G., & Gosling, J. (2008). Tensions in higher education leadership: Towards a multi-level model of leadership practice. *Higher Education Quarterly, 62*(4), 358–376.

Bolden, R., Petrov, G., & Gosling, J. (2009). Distributed leadership in higher education: Rhetoric and reality. *Educational Management Administration and Leadership, 37*(2), 257–277.

Brew, A. (2008). Disciplinary and interdisciplinary affiliations of experienced researchers. *Higher Education, 56*(4), 423–438.

Bridle, H., Vrieling, A., Cardillo, M., Araya, Y., & Hinojosa, L. (2013). Preparing for an interdisciplinary future: A perspective from early-career researchers. *Futures, 53*, 22–32.

Bromme, R. (2000). Beyond one's own perspective: The psychology of cognitive interdisciplinarity. In P. Weingart & N. Stehr (Eds.), *Practising interdisciplinarity* (pp. 115–133). Toronto: University of Toronto Press.

Brumfit, C. (2004). Applied linguistics in 2004. Unity in diversity In S. M. Gass and S. Makoni, *World Applied Linguistics. A Celebration of 40 Years of AILA. AILA Review, 17*, 133–136.

Bryman, A. (2006). Paradigm peace and the implications for quality. *International Journal of Social Research Methodology, 9*(2), 111–126.

Bryman, A., & Lilley, S. (2009). Leadership researchers on leadership in higher education. *Leadership, 5*(3), 331–346.

Burns, J. M. (1978). *Leadership*. New York: Harper and Row.

Buysse, L. (2012). *So* as a multifunctional discourse marker in native and learner speech. *Journal of Pragmatics, 44*(13), 1764–1782.

Calvert, J., & Fujimura, J. H. (2011). Calculating life? Duelling discourses in interdisciplinary systems biology. *Studies in History and Philosophy of Biological and Biomedical Sciences, 42*, 155–163.

Campbell, D. T. (1969). Ethnocentrism of disciplines and the fish-scale model of omniscience. In M. Sherif & C. W. Sherif (Eds.), *Interdisciplinary relationships in the social sciences* (pp. 328–348). Chicago: Aldine Publishing.

Choi, S. (2016). The case for open source software: The interactional discourse lab. *Applied Linguistics, 37*(1), 100–120.

Choi, S. (2017). Collaborating beyond boundaries. In J. Angouri, J. Holmes, & M. Marra (Eds.), *Negotiating boundaries at work: Talking and transitions*. Edinburgh: Edinburgh University Press.

Choi, S., & Richards, K. (2012). Turn-taking in interdisciplinary scientific research meetings: Using 'R' for a simple and flexible tagging system. In M. Haugh, S. Ruhi, T. Schmidt, & K. Wörner (Eds.), *Best practices for speech corpora in linguistic research* (pp. 37–42). Ankara: Middle East Technical University.

Choi, S., & Schnurr, S. (2014). Exploring distributed leadership: Solving disagreements and negotiating consensus in a 'leaderless' team. *Discourse Studies, 16*(1), 3–24.

Cianciolo, A. T., & Sternberg, R. J. (2004). *A brief history of intelligence*. Malden: Blackwell.

Clark, H. H. (1996). *Using language*. Cambridge: Cambridge University Press.

Clark, M. (2006). A case study in the acceptance of a new discipline. *Studies in Higher Education, 31*(2), 133–148.

Clarke, A. (2005). Commentary 1: Professional theories and institutional interaction. *Communication & Medicine, 2*(2), 189–191.

Clifton, J. (2006). A conversation analytical approach to business communication. *Journal of Business Communication, 43*(3), 202–219.

Clifton, J. (2012). A discursive approach to leadership: Doing assessments and managing organizational meanings. *Journal of Business Communication, 49*, 148–168.

Clifton, J. (2015). Leaders as ventriloquists: Leader identity and influencing the communicative construction of the organisation. *Leadership*, Online. doi: 10.1177/1742715015584695

Cook, G. (2015). Birds out of dinosaurs: The death and life of applied linguistics. *Applied Linguistics*, *36*(4): 425–433.

Copland, F., & Creese, A. (2015). *Linguistic ethnography: Collecting, analysing and presenting data*. London: Sage.

Creamer, E. G. (2005). Insight from multiple disciplinary angles: A case study of an interdisciplinary research team. *New Directions in Teaching and Learning, 102*, 37–44.

Curry, L. A., O'Cathain, A., Plano Clark, V. L., Aroni, R., Fetters, M., & Berg, D. (2012). The role of group dynamics in mixed methods health sciences research teams. *Journal of Mixed Methods Research, 6*(1), 5–20.

Darbellay, F. (2015). Rethinking inter- and transdisciplinarity: Undisciplined knowledge and the emergence of a new thought style. *Futures, 65*, 163–174.

Davies, A., & Elder, C. (2004). Applied linguistics: Subject to discipline. In A. Davies & C. Elder (Eds.), *The handbook of applied linguistics* (pp. 1–15). Oxford: Blackwell.

Day, D. V., Gronn, P., & Salas, E. (2004). Leadership capacity in teams. *The Leadership Quarterly, 15*, 857–880.

De Bot, K. (2015). *A history of applied linguistics: From 1980 to the present*. London: Routledge.

della Chiesa, B., Christoph, V., & Hinton, C. (2009). How many brains does it take to build a new light: Knowledge management challenges of a transdisciplinary project. *Mind, Brain, and Education, 3*(1), 17–26.

Derry, S. J., DuRussel, L. A., & O'Donnell, A. M. (1997). *Individual and distributed cognitions in interdisciplinary teamwork: A developing case study and emerging theory*. Madison: National Institute for Science Education University of Wisconsin-Madison.

Díaz, F., Antaki, C., & Collins, A. F. (1996). Using completion to formulate a statement collectively. *Journal of Pragmatics, 26*(4), 525–542.

Donald, J. (2002). *Learning to think: Disciplinary perspectives*. San Francisco: Jossey-Bass.

Donato, R. (2004). Aspects of collaboration in pedagogic discourse. *Annual Review of Applied Linguistics, 24*, 284–302.

Donnellon, A. (1996). *Team talk: The power of language in team dynamics*. Boston: Harvard Business School Press.

Drath, W. H., McCauley, C. D., Palus, C. J., Van Velsor, E., O'Connor, P. M. G., & McGuire, J. B. (2008). Direction, alignment, commitment: Toward a more integrative ontology of leadership. *Leadership Quarterly, 19*, 635–653.

Drew, P. (1994). Conversation analysis. In R. E. Asher (Ed.), *Encyclopedia of language and linguistics* (pp. 749–753). Oxford: Pergamon.

Drew, P., & Heritage, J. (1992). Introduction. In P. Drew & J. Heritage (Eds.), *Talk at work* (pp. 3–65). Cambridge: Cambridge University Press.

Ensley, M. D., Hmieleski, K. M., & Pearce, C. L. (2006). The importance of vertical and shared leadership within new venture top management teams: Implications for the performance of startups. *Leadership Quarterly, 17*, 217–231.

Fairhurst, G. T. (2007). *Discursive leadership: In conversation with leadership psychology*. Thousand Oaks: Sage.

Fairhurst, G. T. (2009). Considering context in discursive leadership research. *Human Relations, 62*(11), 1607–1633.

Fasulo, A., & Zucchermaglio, C. (2002). My selves and I: Identity markers in work meeting talk. *Journal of Pragmatics, 34*, 1119–1144.

Felt, U., Igelsböck, J., Schikowitz, A., & Völker, T. (2013). Growing into what? The (un-)disciplined socialisation of early stage researchers in transdisciplinary research. *Higher Education, 64*, 511–524.

Feyeraband, P. K. (1999). Democracy, élitism, and scientific method. In J. Preston (Ed.), *Paul K. Feyeraband: Knowledge, science and relativism. Philosophical Papers Volume* 3 (pp. 212–226). Cambridge: Cambridge University Press. (Reprinted from Feyeraband, P. K. (1980). Democracy, élitism, and scientific method. *Inquiry*, *23*: 3–18).

Fischer, K. (2006). Towards an understanding of the spectrum of approaches to discourse particles: Introduction to the volume. In K. Fischer (Ed.), *Approaches to discourse particles* (pp. 1–20). Amsterdam: Elsevier.

Fraser, B. (1990). An approach to discourse markers. *Journal of Pragmatics, 14*(3), 383–395.

Fraser, B. (1999). What are discourse markers? *Journal of Pragmatics, 31*(7), 931–952.

Frescoln, L. M., & Arbuckle Jr., J. G. (2015). Changes in perceptions of transdisciplinary science over time. *Futures, 73*, 136–150.

Frey, L. R. (1996). Remembering and 're-membering': A history of theory and research on communication and group decision making. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision making* (2nd ed., pp. 19–51). Thousand Oaks: Sage.

Friboulet, A., & Thomas, D. (2005). Systems biology – An interdisciplinary approach. *Biosensors and Bioelectronics, 20*, 2404–2407.

Friedrich, T. L., & Mumford, M. D. (2009). The effects of conflicting information on creative thought: A source of performance improvements or decrements? *Creativity Research Journal, 21*, 265–281.

Frodeman, R. (2010). Introduction. In R. Frodeman, J. T. Klein, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. xxix–xxxix). Oxford: Oxford University Press.

Frosh, S. (2003). Psychosocial studies and psychology: Is a critical approach emerging? *Human Relations, 56*(12), 1545–1567.

Fuller, S. (2002). *Social epistemology* (2nd ed.). Bloomington: Indiana University Press.

Gardner, S. K., Jansujwicz, J. S., Hutchins, K., Cline, B. & Levesque, V. (2014). Socialization to interdisciplinarity: faculty and student perspectives. *Higher Education, 67*, 255–271.

Garfinkel, H. (1984). *Studies in ethnomethodology*. Cambridge: Polity Press.

Garvin, T. D. (2012). The challenge of classifying 'interdisciplinary research': An exploration. *Current Research Journal of Social Sciences, 4*(4), 323–331.

Gerholm, T. (1990). On tacit knowledge in academia. *European Journal of Education, 25*(3), 263–271.

Gibbs, G., Knapper, C., & Piccinin, S. (2008). Disciplinary and contextually appropriate approaches to leadership of teaching in research-intensive academic departments in higher education. *Higher Education Quarterly, 62*(4), 416–436.

Giere, R. N. (1999). *Science without laws*. Chicago: University of Chicago Press.

Goffman, E. (1981). *Forms of talk*. Philadelphia: University of Pennsylvania Press.

Goodwin, M. H., & Goodwin, C. (1987). Children's arguing. In S. Philips, S. Steele, & C. Tanz (Eds.), *Language, gender, and sex in comparative perspective* (pp. 240–248). Cambridge: Cambridge University Press.

Gordon, C. (2003). Aligning as a team: Forms of conjoined participation in (stepfamily) interaction. *Research on Language and Social Interaction, 36*(4), 395–431.

Gordon, R. D. (2010). Dispersed leadership: Exploring the impact of antecedent forms of power using a communicative framework. *Management Communication Quarterly, 24*, 260–287.

Grabe, W. (2000). Applied linguistics as an emerging discipline. *Annual Review of Applied Linguistics, 2*, 21–27.

Grabe, W. (2010) Applied linguistics: A twenty-first-century discipline. In Robert E. Kaplan (Ed.), *The Oxford handbook of applied linguistics* (2nd ed.). Oxford: Oxford University Press. http://0-www.oxfordhandbooks.com.pugwash.lib.warwick.ac.uk/view/10.1093/oxfordhb/9780195384253.001.0001/oxfordhb-9780195384253-e-2. (Oxford Handbooks Online).

Gray, B. (2008). Enhancing transdisciplinary research through collaborative leadership. *American Journal of Preventive Medicine, 35*, S124–S132.

Green, J., Franquiz, M., & Dixon, C. (1997). The myth of the objective transcript: Transcribing as a situated act. *TESOL Quarterly, 31*(1), 172–176.

Gronn, P. (2002). Distributed leadership as a unit of analysis. *The Leadership Quarterly, 13*, 423–451.

Gronn, P. (2010). Hybrid configurations of leadership. In A. Bryman, D. Collinson, K. Grint, B. Jackson, & M. Uhl-Bien (Eds.), *Sage handbook of leadership* (pp. 435–452). London: Sage.

Hagstrom, W. O. (1971). Inputs, outputs, and the prestige of university science departments. *Sociology of Education, 44*(4), 375–397.

Hamilton, A., Watson, F., Davies, A. L., & Hanley, N. (2009). Interdisciplinary conversations: The collective model. In S. Sörlin & P. Warde (Eds.), *Nature's end: History and the environment* (pp. 162–187). Basingstoke: Palgrave MacMillan.

Hansen, M.-B. M. (1997). Alors and donc in spoken French: A reanalysis. *Journal of Pragmatics, 28*(2), 153–187.

Haythornthwaite, C., Lunsford, K. J., Bowker, G. C., & Bruce, B. (2006). Challenges for research and practice in distributed, interdisciplinary, collaboration. In C. Hine (Ed.), *New infrastructures for science knowledge production* (pp. 143–166). Hershey: Idea Group.

Heimeriks, G. (2013). Interdisciplinarity in biotechnology, genomics, nanotechnology. *Science and Public Policy, 40*(1), 97–112.

Hellermann, J. (2015). Three contexts for my work as co-editor: Introduction to the special issue. *Applied Linguistics, 36*(4), 419–424.

Hemmings, A., Beckett, G., Kennerly, S. & Yap, T. (2013). Building a community of research practice: Intragroup team social dynamics in interdisciplinary mixed methods. *Journal of Mixed Methods Research, 7*(3), 261–273.

Henkel, M. (2000). *Academic identities and policy change in higher education*. London/Philadelphia: Jessica Kingsley.

Henkel, M., & Vabo, A. (2006). Academic identities. In M. Kogan, M. Bauer, I. Bleiklie, & M. Henkel (Eds.), *Transforming higher education: A comparative study* (2nd ed., pp. 127–159). Dordrecht: Springer.

Hepburn, A., & Wiggins, S. (2007). Discursive research: Themes and debates. In A. Hepburn & S. Wiggins (Eds.), *Discursive research in practice: New approaches to psychology and interaction* (pp. 1–28). Cambridge: Cambridge University Press.

Heritage, J. (1984). A change-of-state token and aspects of its sequential placement. In J. M. Atkinson & J. Heritage (Eds.), *Structures of social action: Studies in conversation analysis* (pp. 299–345). Cambridge: Cambridge University Press.

Heritage, J. (1995). Conversation analysis: methodological aspects. In U. M. Quasthoff (Ed.), *Aspects of oral communication* (pp. 391–418). Berlin: de Gruyter.

Heritage, J. (2012a). Epistemics in action. Action formation and territories of knowledge. *Research on Language and Social Interaction, 45*(1), 1–29.

Heritage, J. (2012b). The epistemic engine: Sequence organization and territories of knowledge. *Research on Language and Social Interaction, 45*(1), 30–52.

Heritage, J. (2013). Turn-initial position and some of its occupants. *Journal of Pragmatics, 57*, 331–337.

Heritage, J., & Geoffrey, R. (2005). The terms of agreement: Indexing epistemic authority and subordination in talk-in-interaction. *Social Psychology Quarterly, 68*(1), 15–38.

Heritage, J., & Maynard, D. W. (2006). Problems and prospects in the study of physician-patient interaction: 30 years of research. *Annual Review of Sociology, 32*, 351–374.

Heritage, J., & Raymond, G. (2005). The terms of agreement: Indexing epistemic authority and subordination in talk-in-interaction. *Social Psychology Quarterly, 68*(1), 15–38.

Hersey, P., & Blanchard, K. H. (1969). *Management of organizational behaviour*. Englewood Cliffs: Prentice-Hall.

Holbook, J. B. (2013). What is interdisciplinary communication? Reflections on the very idea of disciplinary integration. *Synthese, 190*, 1865–1879.

Holley, K. A. (2009). Interdisciplinary strategies as transformative change in higher education. *Innovative Higher Education, 34*, 331–344.

Holmes, J., Marra, M., & Vine, B. (2011). *Leadership, discourse, and ethnicity*. Cambridge: Cambridge University Press.

House, R. J. (1971). A path–goal theory of leader effectiveness. *Administrative Science Quarterly, 16*, 321–338.

Housley, W. (2000). Category work and knowledgeability within multidisciplinary team meetings. *Text, 20*(1), 83–107.

Huber, L. (1990). Disciplinary cultures and social reproduction. *European Journal of Education, 25*(3), 241–261.

Hunt, L. (1994). The virtues of disciplinarity. *Eighteenth-Century Studies, 28*(1), 1–7.

Hurford, J. R., & Heasley, B. (1983). *Semantics: A course book*. Cambridge: Cambridge University Press.

Huutoniemi, K., Klein, J. T., Bruun, H. & Hukkinen, J. (2010). Analyzing interdisciplinarity: Typology and indicators. *Research Policy, 39*(1), 79–88.

Jacobs, J. A., & Frickel, S. (2009). Interdisciplinarity: A critical assessment. *Annual Review of Sociology, 35*, 43–65.

Jefferson, G. (1981). The abominable *ne*? An exploration of post-response pursuit of response. In P. Shroder (Ed.), *Sprache der Gegenwaart* (pp. 53–88). Düsseldorf: Pedagogischer Verlag Schwann.

Jefferson, G. (1984). Notes on a systematic deployment of the acknowledgement tokens ‘Yeah’, and ‘Mm Hm’. *Research on Language and Social Interaction, 17*(2), 197–216.

Jefferson, G. (1987). On exposed and embedded correction in conversation. In G. Button & J. Lee (Eds.), *Talk and social organisation* (pp. 86–100). Clevedon: Multilingual Matters.

Jefferson, G. (1989). Preliminary notes on a possible metric which provides for a ‘standard maximum’ silence of approximately one second in conversation.

In D. Roger & P. Bull (Eds.), *Conversation* (pp. 166–196). Clevedon: Multilingual Matters.

Johnson, A. (2002). So…?: Pragmatic implications of so-prefaced questions in formal police interviews. In J. Cotterill (Ed.), *Language in the legal process* (pp. 91–110). New York: Palgrave MacMillan.

Jovchelovitch, S. (2007). *Knowledge in context: Representations, community and culture*. London: Routledge.

Kalra, P., & O'Keeffe, J. K. (2011). Communication in mind, brain and education: Making disciplinary differences explicit. *Mind, Brain and Education, 5*(4), 16–171.

Kangasharju, H. (1996). Aligning as a team in multiparty conversation. *Journal of Pragmatics, 26*(3), 291–319.

Katze, M. G. (2013). Preface. In M. G. Katze (Ed.), *Systems biology* (pp. v–x). Berlin: Springer-Verlag.

Kellert, S. H. (2008). *Borrowed knowledge: Chaos theory and the challenge of learning across disciplines*. Chicago: The University of Chicago Press.

Kessel, F., & Rosenfield, P. L. (2008). Preface to the new edition. In F. Kessel, P. L. Rosenfield, & N. B. Anderson (Eds.), *Interdisciplinary research: Case studies from health and social science* (pp. ix–xx). Oxford: Oxford University Press.

Kirschner, M. W. (2005). The meaning of systems biology. *Cell, 121*(4), 503–504.

Kitano, H. (Ed.). (2001). *Foundations of systems biology*. Cambridge, MA: The MIT Press.

Kitano, H. (2002). Systems biology: A brief overview. *Science, 295*, 1662–1664.

Klein, J. T. (1990). *Interdisciplinarity: History, theory and practice*. Detroit: Wayne State University Press.

Klein, J. T. (2005). *Humanities, culture, and interdisciplinarity: The changing American academy*. Albany: State University of New York Press.

Klein, J. T. (2010). A taxonomy of interdisciplinarity. In R. Frodeman, J. T. Klein, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 15–30). Oxford: Oxford University Press.

Knorr Cetina, K. (1999). *Epistemic cultures: How the scientists make knowledge*. Cambridge, MA: Harvard University Press.

Kockelmans, J. J. (1979). Why interdisciplinarity. In J. J. Kockelmans (Ed.), *Interdisciplinarity and higher education* (pp. 123–160). University Park/London: Pennsylvania State University Press.

Kogan, M. (2000). Higher education communities and academic identities. *Higher Education Quarterly, 54*(3), 207–216.

Koshik, I. (2002). Designedly incomplete utterances: A pedagogical practice for eliciting knowledge displays in error correction sequences. *Research on Language and Social Interaction, 35*(3), 277–309.

Kotthoff, H. (1993). Disagreement and concession in disputes: On the context sensitivity of preference structures. *Language in Society, 22*, 19–216.

Kramsch, C. (2015). Applied linguistics: A theory of the practice. *Applied Linguistics, 36*(4), 454–465.

Krause, K.-L. D. (2014). Challenging perspectives on learning and teaching in the disciplines: The academic voice. *Studies in Higher Education, 39*(1), 2–19.

Kreber, C. (2000). How university teaching award winners conceptualise academic work: Some further thoughts on the meaning of scholarship. *Teaching in Higher Education, 5*, 61–78.

Krohn, W. (2010). Interdisciplinary cases and disciplinary knowledge. In R. Frodeman, J. T. Klein, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 31–49). Oxford: Oxford University Press.

Lakhani, J., Benzies, K., & Hayden, K. A. (2012). Attributes of interdisciplinary research teams: A comprehensive review of the literature. *Clinical and Investigative Medicine, 35*(5), E260–E265.

Lam, P. W. Y. (2009). The effect of text type on the use of so as a discourse particle. *Discourse Studies, 11*(3), 353–372.

Lam, P. W. Y. (2010). Toward a functional framework for discourse particles: A comparison of well and so. *Text & Talk, 30*(6), 657–675.

Lattuca, L. R. (2001). *Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty*. Nashville: Vanderbilt University Press.

Lattuca, L. R. (2002). Learning interdisciplinarity: Sociocultural perspectives on academic work. *The Journal of Higher Education, 73*(6), 711–739.

Lau, L., & Pasquani, M. (2008). 'Jack of all trades'? The negotiation of interdisciplinarity within geography. *Geoforum, 39*, 552–560.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Lawler, S. (2014). *Identity: Sociological perspectives* (2nd ed.). Cambridge: Polity Press.

Lee, D. Y. W. (2008). Corpora and discourse analysis: New ways of doing old things. In V. K. Bhatia, J. Flowerdew, & R. H. Jones (Eds.), *Advances in discourse studies* (pp. 86–99). London: Routledge.

Leithwood, K., Day, C., Sammons, P., Harris, A., & Hopkins, D. (2006). *Successful school leadership: What it is and how it influences pupil learning*. Nottingham: DfES Publications.

Lerner, G. H. (1991). On the syntax of sentences-in-progress. *Language in Society, 20*, 441–458.

Lerner, G. H. (1996). On the 'semi-permeable' character of grammatical units in conversation: Conditional entry into the turn space of another speaker. In E. Ochs, E. A. Schegloff, & S. A. Thompson (Eds.), *Interaction and grammar* (pp. 238–276). Cambridge: Cambridge University Press.

Lerner, G. H. (2002). Turn-sharing: The choral co-production of talk-in-interaction. In C. E. Ford, B. A. Fox, & S. A. Thompson (Eds.), *The language of turn and sequence* (pp. 225–256). Oxford: Oxford University Press.

Lindström, A., & Mondada, L. (2009). Assessments in social interaction: Introduction to the special issue. *Research on Language and Social Interaction, 42*(4), 299–308.

Lingard, L., Schryer, C. F., Spafford, M. M., & Campbell, S. L. (2007). Negotiating the politics of identity in an interdisciplinary research team. *Qualitative Research, 7*, 501–519.

Lloyd, R. (1939). *The golden middle age*. London: Longmans.

López-Yáñez, J., & Altopiedi, M. (2015). Evolution and social dynamics of acknowledged research groups. *Higher Education, 70*, 629–647.

Lyall, C., & Meagher, L. R. (2012). A masterclass in interdisciplinarity: Research into practice in training the next generation of interdisciplinary researchers. *Futures, 44*, 608–617.

Lyall, C., Bruce, A., Tait, J., & Meagher, L. (2011). *Interdisciplinary research journeys: Practical strategies for capturing creativity*. London: Bloomsbury Academic.

Lynch, M. (1985). *Art and artefact in laboratory science: A study of shop work and shop talk in a laboratory*. London: Routledge.

Lyne, J. (1990). Bio-rhetorics: Moralizing the life sciences. In H. W. Simons (Ed.), *The rhetorical turn: Invention and persuasion in the conduct of inquiry* (pp. 35–57). Chicago: University of Chicago Press.

Mackey, J. L. (2002). Rules are not the way to do interdisciplinarity: A response to Szostak. *Issues in Integrative Studies, 20*, 123–129.

MacMynowski, D. P. (2007). Pausing at the brink of interdisciplinarity: Power and knowledge at the meeting of social and biophysical science. *Ecology and Society, 12*(1): Article 20. http://www.ecologyandsociety.org/vol12/iss1/art20/. Accessed 15 Feb 2014.

Mailhot, C., Gagon, S., Langley, A., & Louis-Felix, B. (2016). Distributed leadership across people and objects in a collaborative research project. *Leadership, 12*(1), 53–85.

Mann, S. (2011). A critical review of qualitative interviews in applied linguistics. *Applied Linguistics, 32*(1), 6–24.

Manor-Binyamini, I. (2011). A model of ethnographic discourse analysis for an interdisciplinary team. *Journal of Pragmatics, 43*, 1997–2011.

Mansilla, V. B. (2008). Patterned diversity in interdisciplinary dialogues: Lessons from an empirical study of interdisciplinary research at the frontier. In F. Darbellay, M. Cockell, J. Billotte, & F. Waldvogel (Eds.), *A vision of transdisciplinarity: Laying foundations for a world knowledge dialogue* (pp. 137–147). Boca Raton: EPFL Press.

McCallin, A. (2001). Interdisciplinary practice – A matter of teamwork: An integrated literature review. *Journal of Clinical Nursing, 10*, 419–428.

McCallin, A. (2004). Pluralistic dialoguing: A theory of interdisciplinary teamworking. *Grounded Theory Review*, *4*(1). http://groundedtheoryreview.com/2004/11/30/1605/. Accessed 24 Feb 2015.

Mehra, A., Smith, B. R., Dixon, A. L., & Robertson, B. (2006). Distributed leadership in teams: The network of leadership perceptions and team performance. *Leadership Quarterly, 17*, 232–245.

Mercer, N. (2000). *Words and minds: How we use language to think together*. London: Routledge.

Metzger, W. (1987). The academic profession in the United States. In B. Clark (Ed.), *The academic profession* (pp. 123–208). Berkeley: University of California Press.

Middlehurst, R. (2008). Not enough science or not enough learning? Exploring the gaps between leadership theory and practice. *Higher Education Quarterly, 62*(4), 322–339.

Middlehurst, R., Goreham, H., & Woodfield, S. (2009). Why research leadership in higher education: Exploring contributions from the UK's leadership foundation in higher education. *Leadership, 5*, 311–328.

Misra, S., Hall, K., Feng, A., Stipelman, B., & Stokols, D. (2011). Collaborative processes in transdisciplinary research. In M. Kirst, N. Schaefer-McDaniel, S. Hwang, & P. O'Campo (Eds.), *Converging disciplines: A transdisciplinary research approach to urban health problems* (pp. 97–110). New York: Springer.

Moran, J. (2010). *Interdisciplinarity* (2nd ed.). London: Routledge.

Morris, R. T., & Seeman, M. (1950). The problem of leadership: An interdisciplinary approach. *American Journal of Sociology, 56*(2), 149–155.

Morrison, P. S., Dobie, G., & McDonald, F. J. (2003). Research collaboration among university scientists. *Higher Education Research & Development, 22*(3), 275–296.

Mumby, D. (2001). Power and politics. In F. Jablin & L. Putnam (Eds.), *The new handbook of organizational communication: Advances in theory, research, and methods* (pp. 585–623). London: Sage.

Murray, H. & Renaud, R. (1995). Disciplinary differences in classroom teaching behaviors. In N. Hativa (Ed.), *Disciplinary differences in teaching and learning: Implications for practice* (pp. 31–40). San Francisco: Jossey-Bass.

Myers, G. (1990). *Writing biology: Texts in the construction of scientific knowledge*. Madison: University of Wisconsin Press.

National Academies. (2005). *Facilitating interdisciplinary research*. National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. Washington, DC: The National Academies Press.

Newell, W. H. (2001). A theory of interdisciplinary studies. *Issues In Integrative Studies, 19*, 1–25.

Nielsen, M. (2009). Interpretive management in business meetings. Understanding managers' interactional strategies through conversation analysis. *Journal of Business Communication, 46*, 23–56.

Northouse, P. G. (2004). *Leadership: Theory and practice* (3rd ed.). Thousand Oaks: Sage.

Nowotny, H. (2003). Science in search of its audience. *Nova Acta Leopoldina, NF, 87*(325), 211–215.

O'Connor, K., & Yates, L. (2014). Disciplinary representation on institutional websites: Changing knowledge, changing power? *Journal of Educational Administration and History, 46*(1), 1–16.

O'Keefe, B. J., & Benoit, P. J. (1982). Children's arguments. In J. R. Cox & C. A. Willard (Eds.), *Advances in argumentation theory and research* (pp. 154–183). Carbondale/Edwardsville: Southern Illinois University Press.

O'Malley, M. A., & Dupré, J. (2005). Fundamental issues in systems biology. *BioEssays, 27*, 1270–1276.

O'Neill, A., & Meek, V. L. (1994). Academic professionalism and the self-regulations of performance. *Journal of Tertiary Education Administration, 16*(1), 93–107.

Öberg, G. (2009). Facilitating interdisciplinary work: Using quality assessment to create common ground. *Higher Education, 57*, 405–415.

Ochs, E. (1979). Transcription as theory. In E. Ochs & B. B. Schiefflin (Eds.), *Developmental pragmatics* (pp. 43–72). New York: Academic Press.

Ochs, E., & Jacoby, S. (1997). Down to the wire: The cultural clock of physicists and the discourse of consensus. *Language in Society, 26*, 479–505.

Ochs, E., Jacoby, S., & Gonzales, P. (1994). Interpretive journeys: How physicists talk and travel through graphic space. *Configurations, 2*(1), 151–171.

Organization for Economic Cooperation and Development (OECD). (1972). *Interdisciplinarity: Problems of teaching and research in universities*. Organization for Economic Cooperation and Development.

Palmer, C. L. (1999). Structures and strategies of interdisciplinary science. *Journal of American Society for Information Science, 50*(3), 242–253.

Pearce, C., & Conger, J. A. (2003). *Shared leadership: Reframing the hows and whys of leadership*. London: Sage.

Pearce, C. L., & Sims Jr., H. P. (2002). Vertical versus shared leadership as predictors of the effectiveness of change management teams: An examination of aversive, directive, transactional, transformational and empowering leader behaviors. *Group Dynamics, 6*, 172–197.

Petrie, H. G. (1976). Do you see what I see? The epistemology of interdisciplinary inquiry. *Journal of Aesthetic Education, 10*(1), 29–43.

Pomerantz, A. (1984a). Giving a source or basis: The practice in conversation of telling 'how I know'. *Journal of Pragmatics, 8*, 607–625.

Pomerantz, A. (1984b). Agreeing and disagreeing with assessments: Some features of preferred/dispreferred turn shapes. In J. M. Atkinson & J. Heritage (Eds.), *Structures of social action: Studies in conversation analysis* (pp. 57–101). Cambridge: Cambridge University Press.

Poole, M. S., & Hirokawa, R. Y. (1996). Introduction: Communication and group decision making. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision making* (2nd ed., pp. 3–18). Thousand Oaks: Sage.

Potter, J., & Hepburn, A. (2005). Qualitative interviews in psychology: Problems and possibilities. *Qualitative Research in Psychology, 2*, 1–27.

Qin, J., Lancaster, F. W., & Allen, B. (1997). Types and levels of interaction in interdisciplinary research in the sciences. *Journal of the American Society for Information Science, 48*(10), 893–916.

Redeker, G. (1990). Ideational and pragmatic markers of discourse structure. *Journal of Pragmatics, 14*(3), 367–381.

Redeker, G. (1991). Linguistic markers of discourse structure. *Linguistics, 29*, 1139–1172.

Reich, S. M., & Reich, J. A. (2006). A cultural competence in interdisciplinary collaborations: A method for respecting diversity in research partnerships. *American Journal of Community Psychology, 38*, 51–62.

Reinalter, H. (1996). Interdisciplinarity in theory and practice. *Journal of Area Studies, 4*(9), 154–158.

Repko, A. F. (2007). Integrating interdisciplinarity: How the theories of common ground and cognitive interdisciplinarity are informing the debate on interdisciplinary integration. *Issues in Integrative Studies, 25*, 1–31.

Repko, A. F. (2008). *Interdisciplinary research: Process and theory*. Los Angeles: Sage.

Richards, D. G. (1996). The meaning and relevance of 'synthesis' in interdisciplinary studies. *The Journal of Education, 45*(2), 114–128.

Richards, K. (2005). Introduction. In K. Richards & P. Seedhouse (Eds.), *Applying conversation analysis* (pp. 1–15). Basingstoke: Palgrave MacMillan.

Richards, K. (2007). Knowing when to 'no': Aspects of alignment in professional relationships. In H. Bowles & P. Seedhouse (Eds.), *Conversation analysis and languages for specific purposes* (pp. 69–98). Bern: Peter Lang.

Richards, K. (2009). A hard act to follow: Conference debate and student argument. In M. Gotti (Ed.), *Commonality and individuality in English academic discourse* (pp. 83–113). Bern: Peter Lang.

Roberts, C., & Sarangi, S. (2005). Theme-oriented discourse analysis of medical encounters. *Medical Education, 39*, 632–640.

Robertson, D. W., Martin, D. K., & Singer, P. A. (2003). Interdisciplinary research: Putting methods under the microscope. *BMC Medical Research Methodology, 3*, 20. http://www.biomedcentral.com/1471-2288/3/20. Accessed 15 Feb 14.

Rossini, F. A., & Porter, A. L. (1984). Interdisciplinary research: Performance and policy issues. In R. Jurkovich & J. H. P. Paelinck (Eds.), *Problems in interdisciplinary studies* (pp. 26–45). Brookfield: Gower.

Rost, J. (1991). *Leadership for the twenty-first century*. New York: Praeger.

Rowe, J. W. (2008). Introduction: Approaching interdisciplinary research. In F. Kessel, P. L. Rosenfield, & N. B. Anderson (Eds.), *Interdisciplinary research: Case studies from health and social science* (pp. 3–9). Oxford: Oxford University Press.

Sa, C. (2008). Interdisciplinary strategies in US research universities. *Higher Education, 55*(5), 537–552.

Sacks, H. (1987). On the preferences for agreement and contiguity in sequences in conversation. In G. Button & J. R. E. Lee (Eds.), *Talk and social organisation* (pp. 54–69). Clevedon: Multilingual Matters.

Sacks, H. (1992). In G. Jefferson (Ed.), *Lectures on conversation* (Vol. 1). Oxford: Blackwell.

Salter, L., & Hearn, A. (1996). *Outside the lines: Issues in interdisciplinary research*. Montreal: McGill-Queen's University Press.

Sarangi, S. (2005). Social interaction, social theory and work-related activities. *Calidoscópio, 3*(3), 160–169.

Sarewitz, D. (2010). Against holism. In R. Frodeman, J. T. Klein, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 65–75). Oxford: Oxford University Press.

Schegloff, E. A. (1980). Preliminaries to preliminaries: 'Can I ask you a question?' *Sociological Inquiry, 50*, 104–152.

Schegloff, E. A. (1982). Discourse as an interactional achievement: Some uses of 'uh huh' and other things that come between sentences. In E. A. Schegloff & D. Tannen (Eds.), *Analyzing discourse: Text and talk* (pp. 71–93). Washington, DC: Georgetown University Press.

Schegloff, E. A. (1987a). Recycled turn beginnings: A precise repair mechanism in conversation's turn-taking organization. In G. Button & J. R. E. Lee (Eds.), *Talk and social organization* (pp. 70–85). Clevedon: Multilingual Matters.

Schegloff, E. A. (1987b). Between micro and macro: Contexts and other connections. In J. C. Alexander, B. Giesen, R. Münch, & N. J. Smelser (Eds.), *The micro-macro link* (pp. 207–234). Berkeley: University of California Press.

Schegloff, E. A. (1991). Reflections on talk and social structure. In D. Boden & D. H. Zimmerman (Eds.), *Studies in ethnomethodology and conversation analysis* (pp. 44–70). London: Polity Press.

Schegloff, E. A. (2005). Presequences and indirection. Applying speech act theory to ordinary conversation. *Journal of Pragmatics, 12*(1), 55–62.

Schegloff, E., & Sacks, H. (1973). Opening up closings. *Semiotica, 7*(4), 289–327.

Schiffrin, D. (1987a). Discovering the context of an utterance. *Linguistics, 25*(1), 11–32.

Schiffrin, D. (1987b). *Discourse markers*. Cambridge: Cambridge University Press.

Schnurr, S., & Chan, A. (2011). Exploring another side of co-leadership: Negotiating professional identities through face-work in disagreements. *Language in Society, 40*(2), 187–210.

Seedhouse, P. (1997). The case of the missing 'no': The relationship between pedagogy and interaction. *Language Learning, 47*(3), 547–583.

Shulman, L. S. (2002). Foreword. In M. Taylor Huber & S. P. Morreale (Eds.), *Disciplinary styles in the scholarship of teaching and learning: Exploring common ground* (pp. v–ix). Menlo Part: American Association for Higher Education.

Smith, R. (2016). Building 'applied linguistic historiography': Rationale, scope and methods. *Applied Linguistics, 37*(1), 71–87.

Sokolova, T. (2012). Achieving integration in interdisciplinary research: Strategy or emergence? A case study of interdisciplinary research in Sweden. Unpublished Masters thesis in Sustainable Development at Uppsala University, Nr. 109, 63pp., 30 ECTS/hp.

Stan Moran, J. (2010). *Interdisciplinarity* (2nd ed.). London: Routledge.

Stivers, T., & Rossano, F. (2010). Mobilizing response. *Research on Language and Social Interaction, 43*(1), 3–31.

Stivers, T., Mondada, L., & Steensig, J. (2011). Knowledge, morality and affiliation in social interaction. In T. Stivers, L. Mondada, & J. Steensig (Eds.), *The morality of knowledge in conversation* (pp. 3–24). Cambridge: Cambridge University Press.

Stokols, D., Hall, K. L., Moser, R. P., Feng, A., Misra, S., & Taylor, B. K. (2010). Cross-disciplinary team science initiatives: Research, training and translation. In R. Frodeman, J. T. Klein & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 471–493). Oxford: Oxford University Press.

Strathern, M. (2004). *Commons and borderlands: Working papers on interdisciplinarity, accountability and the flow of knowledge*. Oxford: Sean Kingston Publishing.

Strathern, M. (2011). An experiment in interdisciplinarity: Proposals and promises. In C. Camic, N. Gross, & N. Lamont (Eds.), *Social knowledge in the making* (pp. 257–282). Chicago: University of Chicago Press.

Strober, M. H. (2006). Habits of the mind: Challenges for multidisciplinary engagement. *Social Epistemology: A Journal of Knowledge, Culture and Policy, 20*(3–4), 315–331.

Strober, M. H. (2011). *Interdisciplinary conversations: Challenging habits of thought*. Stanford: Stanford University Press.

Stubbe, M., Lane, C., Hilder, J., Vine, E., Vine, B., Marra, M., Holmes, J., & Weatherall, A. (2003). Multiple discourse analyses of a workplace interaction. *Discourse Studies, 5*(3), 351–389.

Suchman, L. (1994). Working relations of technology production and use. *Computer Supported Cooperative Work, 2*, 21–39.

Svennevig, J. (2008). Exploring leadership conversations. *Management Communication Quarterly, 21*, 529–536.

Szostak, R. (2002). How to do interdisciplinarity. *Issues in Integrative Studies, 20*, 103–122.

Tajfel, H. (1982). *Social identity and intergroup relations*. Cambridge: Cambridge University Press.

Tannen, D. (1989). *Talking voices: Repetition, dialogue, and imagery in conversational discourse*. Cambridge: Cambridge University Press.

Thomas, J. (1984). Cross-cultural discourse as 'unequal encounter': Towards a pragmatic analysis. *Applied Linguistics, 5*(3), 226–235.

Tourish, D. (2007). Communication, discourse and leadership. *Human Relations, 60*(11), 1727–1740.

Tracy, K., & Naughton, J. M. (2000). Institutional identity-work: A better lens. In J. Coupland (Ed.), *Small talk* (pp. 62–83). Harlow: Longman.

Trowler, P. (2014). Depicting and researching disciplines: Strong and moderate essentialist approaches. *Studies in Higher Education, 39*(10), 1720–1731.

Turner, S. (2000). What are disciplines? And how is interdisciplinarity different? In P. Weingart & N. Stehr (Eds.), *Practicing interdisciplinarity* (pp. 46–65). Toronto: University of Toronto Press.

Turner, V. K., Benessaiah, K., Warren, S., & Iwaniec, D. (2015). Essential tensions in interdisciplinary scholarship: Navigating challenges in affect, epistemologies, and structure in environment–society research centers. *Higher Education, 70*(4), 649–665.

Uhl-Bien, M. (2006). Relational leadership theory: Exploring the social processes of leadership and organizing. *Leadership Quarterly, 17*, 654–676.

Uhl-Bien, M., Marion, R., & McKelvey, B. (2007). Complexity leadership theory: Shifting leadership from the industrial age to the knowledge era. *Leadership Quarterly, 18*, 298–318.

van Dijk, T. A. (2006). Discourse, context and cognition. *Discourse Studies, 8*(1), 159–177.

van Leeuven, T. (2005). Three models of interdisciplinarity. In R. Wodak & P. Chilton (Eds.), *A new agenda in (critical) discourse analysis* (pp. 3–18). Amsterdam: John Benjamins.

van Rees, M. A. (1992). The adequacy of speech act theory for explaining conversational phenomena: A response to some conversation analytical critics. *Journal of Pragmatics, 17*(1), 31–47.

Walsh, S., Morton, T., & O'Keefe, A. (2011). Analysing university spoken interaction: A CL/CA approach. *International Journal of Corpus Linguistics, 16*(3), 325–344.

Wang, J. (2006). Questions and the exercise of power. *Discourse and Society, 17*(4), 529–548.

Weingart, P., & Stehr, N. (2000). Introduction. In P. Weingart & N. Stehr (Eds.), *Practising interdisciplinarity* (pp. xi–xvi). Toronto: University of Toronto Press.

Whitley, R. (1984). *The intellectual and social organization of the sciences*. Oxford: Clarendon Press.

Widdowson, H. (2000). On the limitations of linguistics applied. *Applied Linguistics, 21*(1), 3–25.

Wiesemes, R., & Karanika-Murray, M. (2009). The cross-disciplinary research group: Overcoming isolation, promoting communication and interdisciplinarity. In M. Karanika-Murray & R. Wiesemes (Eds.), *Exploring avenues to interdisciplinary research: From cross- to multi- to interdisciplinarity* (pp. 1–8). Nottingham: Nottingham University Press.

Wodak, R., Kwon, W., & Clark, I. (2011). Getting people on board: Discursive leadership for consensus building in team meetings. *Discourse and Society, 22*(5), 592–644.

Woods, C. (2007). Researching and developing interdisciplinary teaching: Towards a conceptual framework for classroom communication. *Higher Education, 54*, 853–866.

Yammarino, F. J., Salas, E., Serban, A., Shirreffs, K., & Shuffler, M. L. (2012). Collectivistic leadership approaches: Putting the "we" in leadership science and practice. *Industrial and Organizational Psychology, 5*, 382–402.

Ylijoki, O.-H. (2000). Disciplinary cultures and the moral order of studying: A case study of four Finnish university departments. *Higher Education, 39*(33), 339–362.

Yukl, G. (2012). Effective leadership behaviour: What we know and what questions need more attention. *Academy of Management Perspective, 26*(4), 66–85.

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