Chapter 6

Writing Discipline: Comparing Inscriptions of Knowledge and Knowers in Academic Writing

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Introduction

If academic writing is a form of knowledge making, then differences in knowledge problems or ways of addressing such problems should account for much of the variation among the disciplines.

MacDonald (1994: 21)

Discussions within the applied linguistic field over several decades have concerned the notion of academic discourse communities and the ways in which they might be described (Jolliffe and Brier 1988; MacDonald 1994). Jolliffe and Brier (1988), for example, cite Crane's (1972) discussion of the discourse communities of sociology and mathematics as 'networks of "*invisible colleges*"', and Fish (1980, 1982) on literary criticism and jurisprudence as 'groups of scholars who are constrained by their audience to accept certain methods of reading texts and responding to literature'.

Studies of disciplinary difference continue to proliferate in the literature of the field, made more easily undertaken with the availability of technologies for corpus-based analysis. However, much of the work has been constrained in its explanatory power by limitations in those technologies, as well as in linguistic theories that restrict computational analyses to the level of discrete lexis or syntactic forms. Such studies can describe difference in quantitative distributions of specific wordings or structural elements from one discipline to another (e.g. Hyland 2000). Nonetheless, an intuitive leap is required to move from descriptions of frequency in form to variations in meaning at the level of epistemology. The consequence can be a proliferation of descriptions of difference without taking us closer to understanding 'differences in knowledge problems or ways of addressing such problems' (MacDonald 1994: 21).

On another applied linguistic front are discussions of whether disciplinary entities can be said to exist at all in anything other than a very abstract sense (Casanave 1995; Lundell and Beach 2002). Underlying such claims is typically a preference for ethnographic methods of enquiry that background or even dismiss any close analysis of academic discourse as language, and/or for theoretical models that cannot account for relationships in meanings across discourses. It is apparent that there is much yet to be understood around questions of disciplinarity and the quest becomes more significant in the context of widespread promotion of interdisciplinary research.

Theorizing Knowledge-construction

In this chapter I propose an alternative approach to investigating questions of disciplinarity. Beginning outside of linguistic theory I draw from a Bernsteinian perspective on the sociology of knowledge, connecting initially with Bernstein's construct of *discourses*, differentiating along a continuum from *horizontal discourse* to *vertical discourse*. Horizontal discourse constitutes commonsense knowledge and 'entails a set of strategies that are local, segmentally organised, context-specific and dependent'. *Vertical discourse* or uncommonsense knowledge takes the form of a 'coherent, explicit and systematically principled structure' (Bernstein 1999: 159). Vertical discourse of uncommonsense knowledge is that associated with academic study.

Within the realm of vertical discourse, Bernstein theorized how different intellectual fields or disciplines represent different kinds of knowledge structure (Bernstein 1996, 1999, 2000). At one end of this continuum lie *hierarchical knowledge structures,* typical of the natural sciences, where knowledge accumulates through the integration of knowledge at lower levels 'to create very general propositions and theories' (Bernstein 1999: 162). At the other, are *horizontal knowledge structures* typified by the humanities (e.g. sociology, cultural studies) in which knowledge is built segmentally as 'a series of specialised languages, each with its own specialised modes of interrogation and specialised criteria' (Bernstein 1996: 172–173). The social sciences (e.g. linguistics) can be located somewhere between the two. Wignell (2007) suggests that '[since] the language of the social sciences evolved as a hybrid of the language of the physical sciences and the language of the humanities there is always a kind of dynamic tension between the science and the social in the discourse' (Wignell 2007: 202). (See Martin this volume for a related discussion.)

Building on the work of Bernstein, others in this field of sociology have continued to theorize the ways in which different intellectual fields differ in relation to the production of knowledge. Maton (2007, 2009) challenges, in the spirit of Bernstein, any simple dichotomous interpretation of horizontal and hierarchical knowledge structures in favour of a continuum representing the relative strength or weakness of the integration or segmentation of knowledge.

Maton (2000, 2007, 2006, 2009) then takes the conceptualization of different kinds of knowledge structures a step further. Importantly he argues that claims to knowledge are not just '*of the world',* they are also made '*by authors'* (Maton 2000: 154), and that 'for every knowledge structure there is also a knower structure' (Maton 2007: 88). Just as we can speak of intellectual fields as representing hierarchical or horizontal knowledge structures, so we can also consider them as hierarchical or horizontal knower structures. Maton (2007), for example, illustrates how science can be characterized as a *horizontal knower structure*, in which knowers are segmented by specialized modes of acting, and where the social profile of the scientist is deemed irrelevant to scientific insight, while the humanities can be seen as a *hierarchical knower structure* where knowers are integrated hierarchically in the construction of an ideal knower and knowledge claims are predicated on attributes of knowers – who you are is more important than what you are discussing and how.

In developing LCT, Maton reinterprets these dimensions as two sets of relations, the *epistemic relation* and the *social relation*. The epistemic relation is that 'between educational knowledge and its proclaimed object of study (that part of the world of which knowledge is claimed)'. It concerns what can be known and how. The social relation is that 'between educational knowledge and its author or subject (who is making the claim to knowledge)' (Maton 2000: 154). It concerns who can know. Each of these sets of relations can be relatively stronger or weaker. Stronger epistemic relations give emphasis to the possession of explicit principles, skills and procedures; stronger social relations and give emphasis to the attitudes and dispositions of knowers (Maton 2009: 46). Legitimation Code Theory (LCT) proposes that intellectual fields or disciplines can be differentiated in terms of the relative strength or weakness of their epistemic relations and their social relations (see Figure 6.1).

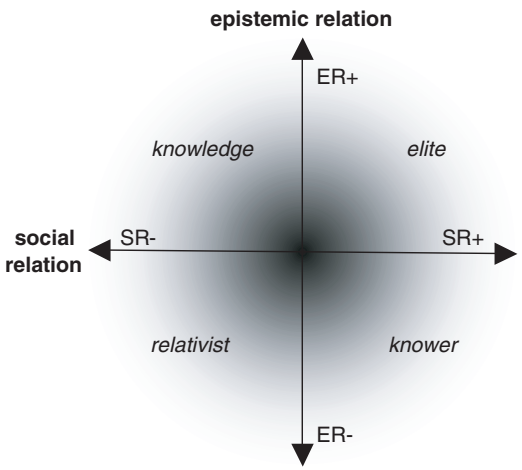

Figure 6.1 Legitimation codes of specialization (from Maton 2007: 97)

LCT theory suggests questions that we might usefully ask in a social semiotic analysis of writing in different intellectual fields. If intellectual fields can be differentiated in terms of the nature of the epistemic relations (what can be known and how) and the social relations (who can know), we can ask how such differences might be instantiated in the discourses, in the key academic genres of those intellectual fields. But what do we look for among the multitude of variations in language from text to text that can generate patterns of difference that we can relate to differences in knowledge-knower structuring of intellectual fields?

Discourses for Legitimizing Knowledge

In this chapter the scope of the quest is narrowed by focusing on one kind of text that is common across a spectrum of intellectual fields, including the sciences, the social sciences and the humanities: the research article. More precisely the focus is on one component of that longer text: the introductory section. Hood (2010) identifies the structuring of this section as a macro-genre constituting a 'research warrant'. It is typically composed of a series of genres, each playing a role in the process of legitimizing a forthcoming contribution to knowledge. While component genres of the macro-genre can vary from factual descriptions and reports to kinds of story genre, the whole invariably functions to persuade a community of readers of the legitimacy of the study reported on. The research warrant provides, then, a relevant site for exploring the kinds of knowers that are implicated and the nature of their contribution to knowledge. The framing question for analysis is essentially that of who gets to say what in the process of legitimization.

The extracts analysed are drawn from published articles across a spectrum of intellectual fields in the natural sciences, social sciences and humanities. They loosely associate around aspects of science – from scientific research itself, to studies of science education. In the case of the latter category the examples are drawn from the realm of social sciences (as applied linguistics research) and from the humanities (as cultural studies research). The issue of typicality is by no means addressed here, although each instance is considered to be legitimate discourse within its intellectual field, given its publication in a reputable journal. Rather, the intention is to begin to explore some of the means by which research writers can and do represent differently the knowledge and knowers they draw on to legitimize their own research. In this way we can begin to open up a richer research space in applied linguistic research for exploring dimensions of disciplinary difference or for evidencing its sometimes claimed demise.

Identifying Projecting Sources as Knowers

At this point some further explanation of aspects of systemic functional linguistic theory is required. In analysing who gets to know, reference is made to the

modelling of interpersonal meaning in discourse as *appraisal* (Martin and White 2005). One aspect of appraisal theory, that of *engagement*, makes a basic distinction between single-voiced or monoglossic discourse and multi-voiced or heteroglossic discourse (Martin and White 2005; after Bakhtin 1935 [1981]). In monoglossic text the writer is the sole knower in the discourse. In heteroglossic discourse, there are a number of linguistic means by which writers construe the presence of other voices. In the analyses in this study I focus on *projection* to identify where writers give voice to other sources by quoting or reporting, the ways in which writers represent those projecting sources, and the nature of what is projected.

Projection can be realized congruently in the grammar of clause relations around projecting mental or verbal processes, as underlined in a, b and c, or in pre-projected 'facts' within a clause, as in d (Halliday and Matthiessen 1999).

a) Halliday (1993) argues // that science has developed a highly sophisticated way of representing ideas.
b) Halliday (1993) claims // 'science has developed a highly sophisticated way of representing ideas'.
c) Halliday (1993) believes // that writing science is especially difficult for students because of the way ideas are represented.
d) The fact that writing science is especially difficult for students is widely appreciated.

Importantly too projection can be realized metaphorically in nominalized mental or verbal processes, as underlined in e and f.

e) There is considerable, although not unanimous, agreement on that.
f) Anderson (2004) offers a number of suggestions. First, . . . Secondly, . . . Finally, . . .

In other instances the projection is signalled only in conventionalized graphological resources, as in the quotation marks in g, or in the bracketed numbers at the end of the clause in h.

g) The many stories and 'radical' fragments within this work can be envisaged as a series of sites to which the reader is exposed.
h) . . . it appears to be a minor substrate in municipal sewage [2, 3].

We can even consider the metaphoric realization of projected feelings in the nominalized behavioural process in i.

i) Everyone joined her in laughter.

When viewed from the perspective of discourse semantics, projection can function within a clause (as in d, e, g, h, i), across a clause complex (as in a, b, c), or

across phases of stages of longer text (as in f). A more detailed discussion of engagement can be found in Martin and White (2005) and for further discussion of projection in academic discourse, see Hood (2010). Here it is sufficient to identify projecting sources and the kind of knowledge that is projected. These two dimensions of projecting sources and projected knowledge frame the analyses in this chapter.

Projecting Sources in the Natural Sciences and the Humanities: Degrees of Visibility

As instances of heteroglossic discourse are located in the data it is quickly apparent that there are significant differences in how projecting voices are represented and what we can know of these voices. Compare, for example, an extract from an introduction to a research article in a science journal in [1] and one from a cultural studies journal on science education in [2]. The locations of projecting sources are underlined.

[1]
Incorporation of organic molecules such as dyes inside solid matrices is an attractive topic of research because of the photostability and fluorescence quantum yield[1–3] of the modified materials. An approach in this regard is to incorporate molecules inside silica spheres[4–5], the advantage of this kind of nanoscopic containers is that they can be used to control the environment of the molecule. [source: Rosemary et al. 2006]

[2]
As I looked around the room, I recognized most of the students as biology majors who had at one time or another stopped by my office. Of the twenty students gathered, most were women; a group of four young men sauntered in together just as the meeting began. As it turned out, many of the attendees had chemistry and biology classes together. Several women mentioned how they wanted to find some old exams, and one person asked if there were class notes from last week's lecture that she missed. After 40 min, Cindy suggested we end the meeting so a group of them could study for an exam together. 'Let's feed our brains!' she yelled. Everyone joined her in laughter. [source: Brandt 2008]

To begin with we can consider the relative visibility of projecting sources in texts from different disciplinary contexts, and the extent to which they are foregrounded or backgrounded in the discourse. Focusing initially on the science text in extract [1] it is evident that the writer uses a citation convention in which sources are referenced with superscript notation outside of the clause structure. The source as researcher/publication is retrievable from a reference

section at the end of the article, but this information is not accessible in the flow of text. Here the projecting source as researcher or author is invisible. By implication what is projected is made more prominent than the projecting source. It is more visible in the discourse and it is thematized. A similar strategy is evident in extract [3]

> [3]
> . . . reduction of these functional groups is carried out using stronger reducing agents like lithium aluminum hydride.[2] Sodium borohydride can, however, be easily modified to stronger or more selective reducing agent.[3] Examples include the borohydride reduction step in the industrial Sumitomo's synthesis of D-biotin (vitamin H)[4] and the selective hydroxy ester reduction in presence of non-substituted esters, employed in the synthesis of *R*-lipoic acid.[5] [source: Saeed and Ashraf 2006]

This is not to say that this is the only means by which propositions are projected in scientific research articles. In [4] a number of semiotic entities are introduced as projecting sources:

> hypotheses explain,
> a proposal hypothesises
> the hypothesis in turn posits a claim, and
> studies suggest.

> [4]
> Many hypotheses have been advanced to explain the chemical composition of infectious prions and the mechanism of their formation in the neurons of infected hosts, but none has yet been proven. Perhaps the most provocative proposal has been the 'protein-only' hypothesis, which posits that the infectious agent is composed exclusively of a misfolded, host-encoded protein called the prion protein (PrP). However, three decades of investigation have yielded no direct experimental proof for this stringent hypothesis. Moreover, various biochemical studies have suggested that nonproteinaceous cofactors may be required to produce infectious prions, possibly by forming physical complexes with PrP (11–4). [source: Surachai Supattapone 2010]

The projecting semiotic sources may be elaborated in various ways, as in

> *Many hypotheses*
> *the most provocative proposal*
> *various biochemical studies*

but the elaborations do not add to the visibility of the researchers and authors that lie behind the proposals, studies and hypotheses.

There are also instances where human voices are projected into the flow of text, as underlined in the opening clause in [5], although here it is a generic reference only.

[5]
Although many researchers believe that acetic acid is an important substrate for the removal of phosphate in anaerobic/aerobic activated sludge (AS) processes [1], it appears to be a minor substrate in municipal sewage [2, 3]. Therefore, novel methods of acetic acid production from sludges are still reported at the present time [4, 5]. [source: Ubukata 2007]

Finally, integral citations that reference the source as researcher+publication (as year) are also found, as in [6] from an applied physics journal.

[6]
Luikov (1975) developed a set of coupled partial differential equations to describe the heat and mass transport in capillary porous media. It was assumed that the transfer of moisture is similar to heat transfer. [source: Younsi et al. 2006]

These examples from the introductions to science articles reveal a continuum of degrees of visibility of projecting sources. There is a strong preference for super-/sub-script notation which means that what is projected is typically given much greater prominence in the discourse than the source of the projection. Where projecting authors themselves are introduced into the discourse, these are always voices from the field of research; they are named as such (*researchers*), or referenced as research publications (*Luikov (1975)*).

In the cultural studies text in [2] the highlighted projecting sources incorporated into the discourse are represented quite differently. They are very visible in the flow of text and are made thematic at clause level, foregrounding the projecting source over that which is projected. The sources referenced in [2] are also of a very different kind. They are not the voices of academic / published sources but of participants within the field of study. The participant voices are introduced as the source of thoughts (*they wanted to find some old exams*), sayings (*Let's . . . she yelled*) and feelings (*everyone joined her in laughter*), and in the process they contribute to the writer's representation of the world observed. Where voices other than the writer's are not present in the discourse, that is, in monoglossic text, we interpret the writer to be the default projecting source. In [2], however, the writer references herself explicitly in this regard, making herself visible as co-present with the participants in the world she is representing, as underlined in

As I looked around the room, I recognized most of the students as biology majors who had at one time or another stopped by my office

A similar strategy is evident in [7].

> [7]
> Aileen, an eighth grade African-American student in a district with school choice at the high-school level, was having a conversation about the process of applying to high schools with several of her peers and me. She said that it was unfair that they did not admit her to the performing arts school because of her low grades in science and math: 'Why do they care about math and science if the school is supposed to teach art? I won't even need science since I am going to be an artist.' Her statements on the issue cohered with others she had made over the course of the school year expressing frustration that she was required to learn science, as she did not feel that it was going to be useful to her in her chosen life path. [source: Olitsky 2006]

Participant voices project representations of the world of which they are part, and the writer also represents herself as co-present:

> *having a conversation . . . with several of her peers and me.*

Other excerpts from cultural studies texts draw on researcher voices in a way similar to that observed in the science extract in [6]. In [8], for example, projecting voices are named as specific authors associated with publications. However, important differences can be noted in the underlined information about the source.

> [8]
> Recently, American Indian women have written autobiographies of their experiences in the academy, providing a look at how they incorporate their vision of themselves as Indigenous women into their framework of academic discourse. Lowrey (1997), from Laguna Pueblo, writes a self-study of her passage through a PhD program in sociology at the University of Washington. In her search for a sense of place in higher education, she hungered for stories of Indigenous people who struggled with the same issues of identity. McKinney (1998), a member of the Potawatomi tribe, uses 'multivocality' or a crosscultural approach in her academic research and writing to represent her 'self.' [source: Brandt 2008]

In these instances the information we are given is elaborated in terms of the heritage and location of the individuals, in other words in terms of their particular 'social gaze' on the world – their past and/or present positions in social space and time (Maton 2010). The elaboration makes the source more 'visible', and implies that the elaborating information is relevant to the status of what is known. The kind of knower is important in the process of legitimation (see Maton 2007 on hierarchy of knowers). Such elaborations may also be of the

writer her/himself as the projecting source, as in [9] and [10]. Here the writers' dispositions are presented as relevant to the process of legitimation of the projected knowledge.

[9]
In this story I position myself as a white Western woman and my values, beliefs, prejudices and aspirations form a complex lens through which I have come to understand myself in a particular social context that was at once strange and familiar over time. [source: Ryan 2008]

[10]
As a feminist researcher, I want to understand and describe this significant transformation of self where one's identities and the doing of science are complexly intertwined. [source: Brandt 2008]

The different representations of projecting sources evident across both sets of extracts (i.e. from the science and from the humanities) can be plotted along a continuum. At one extreme is the invisible voice of extract [1], where the source author/researcher is omitted from the flow of discourse and referenced only by means of a super-/sub-script notation. At the other extreme are voices made integral to the flow of discourse, and elaborated in terms of the locus of the individual knower (e.g. their status as co-present in time and place with what is observed). We can label this dimension as one of +/– visibility, as in Figure 6.2.

The voices in the science texts associate more strongly with the invisible end of the continuum, although they can, as noted in some instances above, drift towards the visible. The voices in the cultural studies texts, on the other hand can occupy the extreme of the highly visible end of the continuum and drift towards less visible.

Returning to the discussion of Legitimation Code Theory in the introduction to this chapter, I suggest that we can interpret this as a representation of relative strength or weakness in the social relations (SR+/–) (Maton 2000, 2007, 2009), where the social relation is that 'between educational knowledge and its author or subject (who is making the claim to knowledge)' (Maton 2000: 154). Stronger social relations give emphasis to the attitudes and dispositions of knowers, while weaker social relations de-emphasize these attitudes and dispositions (Maton 2009: 46). This association is represented in Figure 6.3.

Figure 6.2 The visibility of projecting sources in natural sciences and humanities

Figure 6.3 The visibility of projecting sources in sciences and humanities interpreted as SR+/–

To this point variations in visibility have been considered across a set of science and humanities texts. What then of instances from the introductions to social science research articles?

Projecting Sources in the Social Sciences: Degrees of Visibility

Maintaining a similar focus to the cultural studies texts, the extracts below are from introductions to applied linguistics studies of science classrooms. As with all the extracts represented here, they are drawn from sections of the introduction in which the writer is establishing a warrant for a chosen area of research.

Extract [11] is similar in many respects to the cultural studies texts in [2] and [7]. It is an account of an observation of students in a science classroom. However, in this text there is a move towards a less subjective representation of the writer. While it might be assumed that the writer is co-present with the participants, there is no explicit reference to such. [The shift into the universal present in this observation is discussed at a later point in relation to what is projected.]

[11]
In a middle school science classroom in the suburbs of Washington, DC in 2003, an ethnically and linguistically diverse group of 8th grade students, Philip, Natalie, Gloria, and Sean, discuss the answer to a written question about a scientific phenomenon they are observing at their table. Prompted by a new set of curriculum materials, the students repeatedly refer to, point to, and even make pictures of, the objects of their discussion as these things lie on the table before them. [source: Massoud and Kuipers 2008]

More commonly in the social sciences than in the sciences, sources other than the writer are explicitly referenced in the flow of discourse, either as integral or non-integral to the clause structure. Frequently multiple contributions to a domain of knowledge are referenced, as underlined in [12].

[12]
Laboratory activities have long been advocated in science classrooms as an ideal way for students to challenge naïve conceptions first-hand and develop

> scientific understandings (American Association for the Advancement of Science [AAAS], 1989; Anderson & Smith, 1987; Eliot, 1898; Singer, Hilton, & Schweingruber, 2005). Some researchers (AAAS, 1989; Anderson & Smith, 1987; DeBoer, 1991; Driver, 1983; Singer et al., 2005), however, have discussed the inherent challenges of using laboratory activities with regard to student learning. For example, Millar (2004) suggests that students' experience with natural phenomena in laboratory activities can be messier or more ambiguous than other forms of instruction such as lectures and textbooks and because of this, they may present particular challenges for students trying to learn science. [source: Wright 2008]

Where elaboration occurs in relation to sources in [12], it is not in terms of the locus of the sources as first-hand observer / participant as found in the cultural studies examples. Rather the elaboration is of the sources as *researchers*, opening up a wider set of possibilities in terms of ways of knowing, and reflecting the example from the science text in [5] (*many researchers believe*).

> Some researchers (AAAS, 1989; Anderson & Smith, 1987; DeBoer, 1991; Driver, 1983; Singer et al., 2005)

In other social science texts elaborating information is given about a source as a product rather than a person. In extract [13], the authors are backgrounded in relation to a reference to the product of their research: *Latour and Woolgar's (1986) seminal study.*

> [13]
> Latour and Woolgar's (1986) seminal study provides an ethnographic account of the scientific writing cycle in a professional laboratory. They document how scientists transform raw data by putting them into charts and graphs, and subsequently use them along with articles, books, and grant proposals to produce new articles. In turn, the articles are circulated to colleagues, submitted for publication, and, when published, often become part of the received body of knowledge. [source: Wright 2008]

While authors are named in the first reference to the source, *Latour and Woolgar's (1986) seminal study,* the authors are not the head of the nominal group. They are relegated to the role of pre-modifier for the head (*study*). So the additional information included in the nominal group elaborates on the study not the authors. Because this nominal group occurs within the hyper-theme of the paragraph (Martin 1992, Martin and Rose 2007), it establishes the product (the *study*) rather than the producers (*Latour and Woolgar*) as the point of departure for the proceeding phase of text. However, a tension immediately arises when this non-human source (*study*) is reinterpreted as human source (*They*) in the Theme of the second clause. This tension is perhaps indicative of

a space occupied by the social sciences somewhere between the natural sciences and the humanities.

A similar strategy is evident in the social science text in [14]. Specific sources are referenced with author name as non-integral, bracketed citations at the end of the clause-complex. However, within the structuring of the clause-complex what is given thematic prominence is a semiotic entity (*Recent work in science studies*). It is the semiotic entity that projects (*highlighted, drawn attention to*) the knowledge claims (*the social nature of knowledge production in science; the important role played by the scientific community*). This semiotic source then projects another source, this time a generalized group of knowers (*the scientific community*) that in turn projects (*coming to agreement about*) a decision (*what should count as a discovery, or a new fact, in a given field*).

> [14]
> Recent work in science studies has highlighted the social nature of knowledge production in science and has drawn attention to the important role played by the scientific community, acting in the Literature, in coming to agreement about what should count as a discovery, or a new fact, in a given field (Jasanoff, Markle, Petersen, & Pinch, 1995; Latour, 1987). [source: Viechnicki 2008]

The social science texts observed here occupy the middle ground (Figure 6.4). As with the voices from the humanities texts, they are made visible in the flow of the discourse. However, where there is elaboration it is more like that from the science texts, representing the sources as researcher voices rather than participant voices, or as depersonalized semiotic entities (*science studies, seminal study*).

What Do Sources Project in Discourses of Legitimization in the Natural Sciences and Humanities?

To this point comparisons have been made of the ways in which projecting voices are represented in the discourse, generating a continuum of 'visibility'. At the maximally visible end of the continuum sources are explicitly named as 'sayers' (authors or participants) in the flow of the discourse, where elaborating information is provided on their locus and disposition, and hence the kind of gaze they take on the world. At the minimally visible end sources are removed

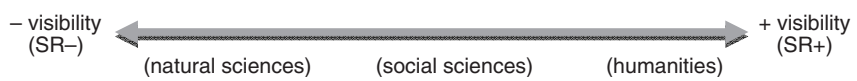

Figure 6.4 The visibility of projecting sources in natural sciences, social sciences and humanities interpreted as SR+/–

from the flow of text to be retrieved from elsewhere in the document. Their presence is backgrounded to that which they project. This leads us to a further consideration: that of variation in what the sources are introduced to contribute to discourses of legitimation. What variations are evident in the nature of what is projected in the instances of the science, humanities and social science texts explored in this study?

First, revisiting extract [1] from the introduction to a journal article in the sciences, projecting sources (super-scripted) are seen to project analytical procedures that underlie observations of the scientific world. These are captured in the underlined wordings in:

> [1]
> Incorporation of organic molecules such as dyes inside solid matrices is an attractive topic of research because of the photostability and fluorescence quantum yield [1–3] of the modified materials. An approach in this regard is to incorporate molecules inside silica spheres,[4–5] [source: Rosemary et al. 2006]

Analytical procedures are represented here as a process (*to incorporate*) and as nominalized processes (*Incorporation; An approach*).

In a longer phase of text in [15] there is a similar pattern of projection of analytical procedures, in this case contributing to observations of the scientific world. References to projected analytical procedures are underlined.

> [15]
> A number of researchers (Fhyr and Rasmuson, 1997; Johanson et al., 1997) solved the equations describing the drying process separately for each phase (gas, liquid and solid). These equations contain various thermophysical properties for each phase. More experimental work is necessary for the determination of these properties. In addition, it is very difficult to identify exactly the boundaries among the phases. Younsi et al. (2006) studied experimentally and numerically the high temperature treatment of wood. The authors used the Luikov's approach for the mathematical formulation. The numerical solution is, however, complicated (Liu and Cheng, 1991). Lewis et al. (1996) and Malan and Lewis (2003) solved the highly non-linear equations describing drying systems using the finite element method. Sanga et al. (2002) solved the diffusion model for transient heat and mass transfer processes to analyse the drying of a shrinking solid surrounding a nonshrinking material using microwave energy. In literature, the models describing the water migration in wood are usually 1D or 2D, which neglect the real variation of thermophysical properties in 3D. Most of the models are developed to simulate conventional drying, and there are few reported studies on the modeling of high temperature treatment of wood. [source: Younsi et al. 2006]

In [15] there is a progressive unfolding of analytic procedures and observations. So, for example, *Malan and Lewis (2003)* draw on an analytical process (*using the finite element method*) in order to arrive at the analytical observation (*highly non-linear equations describing drying systems*). Similarly, *Sanga et al. (2002)* employ an analytical procedure (*using microwave energy*) in order to arrive at the analytical observation (*the diffusion model for transient heat and mass transfer processes* [for] *the drying of a shrinking solid surrounding a nonshrinking material*). Observations are represented both as realized findings (e.g. *solved the equations describing the drying process separately for each phase*) and as yet to be realized findings (e.g. *the boundaries among the phases*).

In these discourses of science, sources other than the writer are introduced to project observations on the world (in these instances the technical world of the laboratory), observations that are reported as arrived at through explicitly articulated processes of analysis, sometimes captured in a nominalized reference to a model or method. We can refer to such discourse as analytical observations.

Observations on the world that is the object of study are certainly not confined to the discourses of science. Returning to the disciplinary domain of cultural studies, we find many instances of such, as for example in [7] and [2] from cultural studies takes on science education.

[7]
Aileen, an eighth grade African-American student in a district with school choice at the high-school level, was having a conversation about the process of applying to high schools with several of her peers and me. She said that it was unfair that they did not admit her to the performing arts school because of her low grades in science and math: 'Why do they care about math and science if the school is supposed to teach art? I won't even need science since I am going to be an artist.' Her statements on the issue cohered with others she had made over the course of the school year expressing frustration that she was required to learn science, as she did not feel that it was going to be useful to her in her chosen life path. [source: Olitsky 2006]

[2]
As I looked around the room, I recognized most of the students as biology majors who had at one time or another stopped by my office. Of the twenty students gathered, most were women; a group of four young men sauntered in together just as the meeting began. As it turned out, many of the attendees had chemistry and biology classes together. Several women mentioned how they wanted to find some old exams, and one person asked if there were class notes from last week's lecture that she missed. After 40 min, Cindy suggested we end the meeting so a group of them could study for an exam together. 'Let's feed our brains!' she yelled, and everyone joined her in laughter. [source: Brandt 2008]

However, in contrast to the observations in the science texts, in the cultural studies texts the observations are represented as arrived at through direct observation either made by the writer her/himself or by others who bear direct witness perhaps as participants in the field that is being observed. There is no reference to any analytical procedures other than a commonsense interpretation of seeing the world, first hand. In [2], for example, the writer makes many references to herself as co-located within the world of the object of study in time and space (*I entered; I noticed; I waved; I felt, etc*). Being in the right place at the right time is constructed in this discourse as key to the legitimation of the observation. This commonsense interpretation may, however, be filtered through a particular kind of gaze or disposition, as was noted above in the discussion of kinds of knowers. So, for example, the writer of [2] later articulates the kind of gaze she directs to the object of study, as evidenced in [10].

> [10]
> As a feminist researcher, I want to understand and describe this significant transformation of self where one's identities and the doing of science are complexly intertwined. [source: Brandt 2008]

We might interpret the following underlined instances in the cultural studies texts in this study as a minimal step towards technicalization of a procedure for observation. However, the underlined wordings refer more to the object of study rather to a process of analysis.

> . . . To self-identify, then, can become a narrative of one's location.
> . . . American Indian women have written autobiographies
> . . . Lowrey (1997), from Laguna Pueblo, writes a self-study of her passage through a PhD program . . .
>
> [source: Brandt]

Once again we can locate these strategies of legitimation along a continuum, this time a continuum to do with the degree of specification of analytical procedures by which observations of the world are arrived at. At one end of the continuum legitimation strategies rely on articulated analytical procedures of enquiry. We can refer to this end as that of analytical observation. At the other end the legitimation strategies rely on the accounts of witnesses to the events, as co-present and as having the right dispositions to know. We can refer to this discourse as testimonial observations. The science texts associate strongly with the former and the humanities texts strongly with the latter. This is represented in Figure 6. 5.

Figure 6.5 Procedures of inquiry in the sciences and humanities

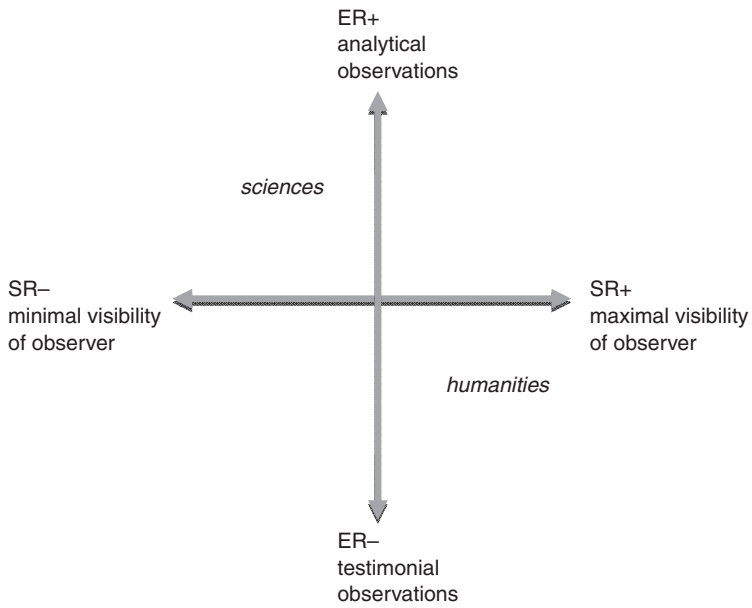

Figure 6.6 (a) A topographic representation of the discourses of legitimization along dimensions of projecting sources and projected observations

With reference to Legitimation Code Theory we can interpret the emphasis on observations based on analytical procedures as stronger epistemic relations, and as a lack of such emphasis as weaker epistemic relations. The dimension of the epistemic relations that is foregrounded in these analyses is that of the *how* of what can be known (Maton 2000), or of what Bernstein calls the external grammar (1996, 2000) and Muller (2000, 2007) refers to as the grammaticality of a theory.

The two dimensions of variation considered in this study can now be brought together into the one topographic representation, as modelled in Figure 6.1 from Maton (2007: xx). Such a representation allows us to map the positions of the different discourses explored in this study (see Figure 6.6 (a)).

To this analysis we need yet to consider the nature of the projection in the social science texts, and where they may now be positioned in the spaces in Figure 6.6 (a).

What Do Sources Project in Discourses of Legitimation in the Social Sciences?

An analysis of the projections in the social science texts once again reveals a position in the middle ground between those from the natural sciences and

those from the humanities, this time along the vertical axis. While there may be less explicit reference to a method of analysis as was frequently the case in the science texts, the social science writers often imply a degree of rigour in analytical procedures that is less evident in the humanities texts. They typically do so through the lexis they choose to encode the process of doing research. So, for example, in the following instances it means differently if the writer chooses the process *explore* or *examine* rather than *look at* to describe the activities engaged in by the researchers.

From social science texts
Halliday and Martin (1993) also set out to explore . . .
Martin (1993) examines . . .

From humanities texts
Deyhle and Margonis (1995) look at

The meaning of *look at* is intensified in *explore* or *examines*, the intensification resulting from the infusion of a circumstance of manner into the material process. In other words *examine* = *look at* + *thoroughly* (see Martin and White 2005; Hood 2010; Hood and Martin 2007 on graduation).

In the humanities texts sources are more often engaged in processes that describe the production of text rather than those that refer to the analysis of data, as for example in:

Davies and Harre´ (2000) speak about 'positioning'
. . . document how students identify with Eurocentric science
Lowrey (1997), from Laguna Pueblo, writes a self-study

At a glance, extract [11] appears to be a testimonial observation of the same kind as the cultural studies text in [7]. But there is a small degree of difference. In [7] the events were represented in the past tense, whereas in [11] they are in the present tense. The universal present tense functions to shift the representation from a specific instance to an instance that symbolizes a kind of interaction, suggesting a level of generalization, perhaps implying the observation referred to as one of a set of observations.

[11]
In a middle school science classroom in the suburbs of Washington, DC in 2003, an ethnically and linguistically diverse group of 8th grade students, Philip, Natalie, Gloria, and Sean, discuss the answer to a written question about a scientific phenomenon they are observing at their table. Prompted be a new set of curriculum materials, the students repeatedly refer to, point to, and even make pictures of, the objects of their discussion as these things lie on the table before them. [source: Massoud and Kuipers 2008]

The generalized representation of observations is also evident in the social science extracts in [16], once again implying the claims are arrived at through multiple observations, in other words somewhat more analytical procedures.

> [16]
> For example, Millar (2004) suggests that students' experience with natural phenomena in laboratory activities can be messier or more ambiguous than other forms of instruction such as lectures and textbooks and because of this, they may present particular challenges for students trying to learn science. [source: Wright 2008]

In [17], in addition to the use of the present tense, there are implications of analytical procedures in the quantification of observations, as underlined

> [17]
> While many researchers have theorized about the importance of writing, Martin, D'Arcy, Newton, and Parker (1994) assert that few have taken an empirical approach to examining the purpose of children's every day writing practices and written work in school settings. In attempting to fill this gap in research, they show that teachers are the primary audience for students' writing and that students seek to please the teacher by choosing topics and language that they think will be favored. They state, 'when children write in school they are usually writing for someone who, they are well aware, knows better than they do what they are trying to say and who is concerned to evaluate their attempt to say it' (p. 45). Furthermore, they observe that students' writing tasks are most often transactional; that is, they require language to be used to directly represent knowledge, as opposed to poetically or expressively. This is especially the case in science classes in which over 90% of writing tasks are transactional. [source: Wright 2008]

Summarizing further, we can locate these discourses from the social sciences as occupying the middle ground in relation to both axes as in Figure 6.6 (b).

A topological representation as in Figure 6.6 (b) is useful in that it captures domains of space to be occupied and allows for degrees of similarity in a way that typological categorizations do not. This is important given the syndromes of features with which writers can position their languages of legitimation. Such diagrammatic representations are also important in alerting us to spaces that are theoretically possible, if not yet identified. A challenge arising from this study, one yet to be explored, is to identify the discourses that might occupy the upper right and bottom left quadrants.

Each of the dimensions in Figure 6.6(b) also constitutes a linguistic translation of aspects of Maton's social and epistemic relations (as represented in Figure 6.1). To the extent that the linguistic translations argued for in this chapter are sound, then the positioning of the discourses of the research

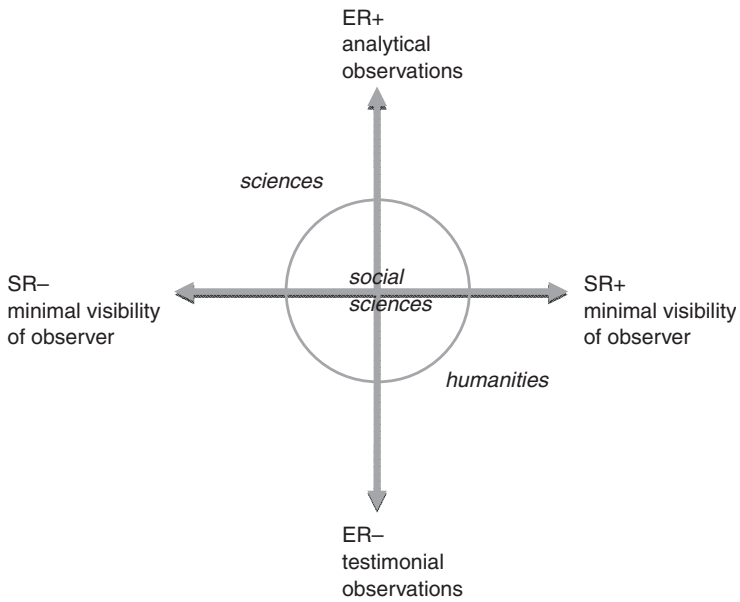

Figure 6.6 (b) A topographic representation of the discourses of legitimation analysed as features of projecting sources and projected observations

warrants characterizes those of the natural sciences as representating a knowledge code, and those of the humanities (or at least these cultural studies texts) as representating a knower code. The implication flowing from such a distinction has to do with their capacities to build knowledge over time, as shown in Maton (2000, 2009, 2010).

Conclusion

There has been much recent discussion in studies of academic literacy around the need to address disciplinary differences. An understanding of the ways in which disciplines use language differently is fundamental to understanding the potential for effective collaboration, and to providing meaningful support for those who study and or research across disciplinary boundaries. This is especially relevant in an evolving academic context in which cross- or trans-disciplinary study is actively encouraged, such as this volume represents.

In applied linguistic studies the response to a concern for understanding disciplinary difference has largely been corpus-based, dominantly focused on identifying disciplinary specific genres or move structures (e.g. Hyland 2000; Huckin 2001; Yang and Allison 2004) or disciplinary preferences for particular grammatical constructions or lexical choices (e.g. Hyland 1999; Hewings and

Hewings 2001). My aim in this chapter has been to broaden the ways in which we conceive and hence analyse disciplinary differences from an applied linguistic perspective. Engaging with sociological theorizations of knowledge-knower structures (e.g. Maton 2007, 2009) has suggested a number of fruitful directions for the linguistic analysis and explanation of difference. What has emerged in the analyses in this chapter is a syndrome of features that reflect differences in the ways in which writers in different disciplines engage with knowers and knowledge in the context constructing the warrant for their own research. Importantly these differences are represented along clines that represent degrees of difference.

It is hoped that the explication of the ways in which different disciplines legitimate research from a linguistic perspective can assist to clarify what may be at stake in debates around transdisciplinary or interdisciplinary studies. It suggests there are different principles of legitimation, different 'rules of the game' that cannot be ignored. If disciplines with different underlying legitimation codes are brought together, there may be a 'code clash', an inability to agree on the grounds of debate that debilitates collaboration and knowledge-building. However, there is a need for more substantial studies of how the dimensions of difference studied here factor out in a wider range of disciplines, how they vary across different academic genres, how they shift over time, and importantly what kind of knowledge-knower structures emerge in interdisciplinary studies of various kinds.

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