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Academic Attribution: Citation and the Construction of Disciplinary Knowledge

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In this paper I explore the ways in which academic citation practices contribute to the construction of disciplinary knowledge. Based on the analysis of a computer corpus of 80 research articles and interviews with experienced writers, the study investigates the contextual variability of citations in eight disciplines and suggests how textual conventions point to distinctions in the ways knowledge is typically negotiated and confirmed within different academic communities. Clear disciplinary differences are identified in both the extent to which writers refer to the work of others and in how they depict the reported information. Writers in the humanities and social sciences employed substantially more citations than scientists and engineers, and were more likely to use integral structures, to employ discourse reporting verbs, and to represent cited authors as adopting a stance to their material. It is argued that these differences in citation practices are related to the fact that academics actively participate in knowledge construction as members of professional groups and that their discoursal decisions are influenced by, and deeply embedded in, the epistemological and social conventions of their disciplines.

INTRODUCTION

Academic knowledge is now generally recognized to be a social accomplishment, the outcome of a cultural activity shaped by ideology and constituted by agreement between a writer and a potentially sceptical discourse community. A substantial literature has shown that the research paper is a rhetorically sophisticated artifact that displays a careful balance of factual information and social interaction (for example Bazerman 1988; Gilbert and Mulkay 1984; Latour and Woolgar 1979). Academic writers do not only need to make the results of their research public, but also persuasive, and their success in gaining acceptance for their work is at least partly dependent on the strategic manipulation of various rhetorical and interactive features. Hedges (Myers 1989; Hyland 1996a and b and 1998a), evaluations (Hunston 1993; Thetela 1997), imperatives (Swales *et al.* 1998), theme (Gosden 1993), and metadiscourse (Crismore and Farnsworth 1990; Hyland, 1998b) are only a few of the elements examined for their contribution to the perilous negotiation of a successful writer-reader relationship.

One of the most important realizations of the research writer's concern for audience is that of reporting, or reference to prior research. This is defined here as the attribution of propositional content to another source. Citation is

central to the social context of persuasion as it can both provide justification for arguments and demonstrate the novelty of one's position (Gilbert 1976; Berkenkotter and Huckin 1995). By acknowledging a debt of precedent, a writer is also able to display an allegiance to a particular community or orientation, create a rhetorical gap for his or her research, and establish a credible writer ethos. But while the literature recognizes the rhetorical importance of citation, we know little about its relative importance, rhetorical functions or realizations in different disciplines. In this paper I will explore the conventions of citation behaviour in a range of academic fields and, through interviews and corpus analysis, seek to reveal some of the purposes embedded in those conventions. First, I need to provide a context for my research by establishing intertextual linkages of my own.

Citation, intertextuality, and the construction of knowledge

The construction of academic facts is a social process, with the cachet of acceptance only bestowed on a claim after negotiation with editors, expert reviewers and journal readers, the final ratification granted, of course, with the citation of the claim by others and, eventually, the disappearance of all acknowledgement as it is incorporated into the literature of the discipline. This process of ratification clearly suggests that writers must consider the reactions of their expected audience to their work, for it is ultimately one's peers who provide the social justification that transforms beliefs into knowledge (Rorty 1979: 170). The fact that there is no independent, objective means of distinguishing observation from presumption means there is generally more than one plausible interpretation for a given piece of data. Readers always have the option of rejecting a writer's message and therefore always play an active role in its construction. One consequence of this delicate process of negotiation is that writers are obliged to situate their research in a larger narrative, and this is most obviously demonstrated through appropriate citation.

Myers (1990) and Berkenkotter and Huckin (1995) have traced the passage of research articles through the review procedure and see the process as one of essentially locating the writer's claims within a wider disciplinary framework. This is achieved partly by modifying claims and providing propositional warrants, but mainly by establishing a narrative context for the work through citation. One of Myers's case study subjects, for example, increased the number of references from 57 to 195 in a resubmission to *Science* (Myers 1990: 91). Both Myers and Berkenkotter and Huckin see academic writing as a tension between originality and humility to the community, rhetorically accommodating laboratory activity to the discipline. So while Berkenkotter and Huckin's scientist subject sought to gain acceptance for original, and therefore significant, work, the reviewers insisted 'that to be science her report had to include an intertextual framework for her local knowledge' (Berkenkotter and Huckin: 59).

Academics generally tend to see research and rhetorical activity as separate. However, appropriate textual practices are vital to the acceptance of claims. Explicit reference to prior literature is a substantial indication of a text's dependence on contextual knowledge and thus a vital piece in the collaborative construction of new knowledge between writers and readers. The embedding of arguments in networks of references not only suggests a cumulative and linear progression, but reminds us that statements are invariably a response to previous statements and are themselves available for further statements by others. Fairclough (1992), extending Bakhtin, refers to these intertextual relations as 'manifest intertextuality', which he distinguishes from 'constitutive intertextuality':

> In manifest intertextuality, other texts are explicitly present in the text under analysis; they are 'manifestly' marked or cued by features on the surface of the text such as quotation marks . . . The constitutive intertextuality of a text, however, is the configuration of discourse conventions that go into its production. (Fairclough 1992: 104)

I will be primarily concerned with manifest intertextuality in this paper although the two are clearly related in academic discourse. Overt reference to specific other texts, and the response of writing to prior writing is an important constitutive feature of research articles, contributing to how we identify and evaluate research writing in different disciplines.

The importance of citation as a constitutive element of the modern academic paper can be seen in its increasingly prominent role in the ways writers seek to construct facts through their communicative practices. Historical research on scientific texts has demonstrated the gradual emergence of the Discussion section to replace Methods as the dominant basis of persuasion (Atkinson 1996; Bazerman 1988; Berkenkotter and Huckin 1995). While partly due to the standardization of experimental procedures, this is largely the result of the increasing contextualization of scientific work in disciplinary problems. Bazerman found, for example, that the number of items in reference lists had risen steadily this century from about 1.5 per article in the *Physical Review* in 1910 to more than 25 in 1980.

Further, references have become more focused, pertinent and integrated into the argument, responding to the fact that 'common theory has become an extremely strong force in structuring articles and binding articles to each other' (Bazerman 1988: 157). Citation helps to define a specific context of knowledge or problem to which the current work is a contribution, and therefore more references are now discussed in greater detail throughout the article. New work has to be embedded in a community-generated literature to demonstrate its relevance and importance and to accommodate readers' scanning patterns as they rapidly search for relevance and newness (Berkenkotter and Huckin 1995: 30).

The ways in which such reports are 'manifestly marked' in academic writing is generally seen as relatively unproblematic due to the highly

developed conventions prescribed in the official manuals of such authorities as the American Psychological Association, Modern Humanities Research Association, American Chemical Society, and Council of Biology Editors. But while providing a relatively stable rhetorical context for efficient communication (Bazerman 1988), these guides convey the impression that writing is mainly a matter of applying established rules. Citation however also represents choices that carry rhetorical and social meanings, and a growing literature has revealed the availability of a wide range of signalling structures and reporting forms (for example Thomas and Hawes 1994; Thompson 1996). One strand of research has therefore sought to demonstrate the rhetorical effects of syntactic features such as thematic position, tense and voice on the reported information (for example Malcolm 1987; Shaw 1992; Swales 1990). Swales (1990: 154), for example, suggests that the present simple–present perfect–past scale, which covers over 90 per cent of finite reporting verbs, represents increasing distance of various kinds from the reported finding.

Two important attribution features of interest to researchers have been the distinction between integral and non-integral structures and the role of different reporting verbs. Integral citations are those where the name of the cited author occurs in the citing sentence while non-integral forms make reference to the author in parenthesis or by superscript numbers (Swales 1990: 148). The use of one form rather than the other appears to reflect a decision to give greater emphasis to either the reported author or the reported message. The use of a reporting verb to introduce the work of other researchers is also a significant rhetorical choice (Hunston 1993; Tadros 1993; Thomas and Hawes 1994; Thompson and Ye 1991). The importance of these verbs lies in the fact that they allow the writer to clearly convey the kind of activity reported and to precisely distinguish an attitude to that information, signalling whether the claims are to be taken as accepted or not.

The inclusion of explicit references to the work of other authors is thus seen as a central feature of academic research writing, helping writers to establish a persuasive epistemological and social framework for the acceptance of their arguments. But there are clear demarcations in the structure of subject-area knowledge systems which are reflected in the fact that different discourse communities negotiate knowledge in different ways (for example Becher 1989; Bruffee 1986; Swales 1990). Both the incidence and use of citation might therefore be expected to differ according to rhetorical contexts, influenced by different ways of seeing the world and of tackling research and its presentation. I will now set out to examine this view, briefly introducing my method, before presenting the general findings and going on to show what they reveal about disciplinary behaviour.

PROCEDURE AND CORPUS

The study is based on a corpus of 80 research articles, consisting of one paper from each of ten leading journals in eight disciplines (appendix): molecular

biology, magnetic physics, marketing, applied linguistics, philosophy, sociology, mechanical engineering, and electronic engineering.[1] These fields were chosen to both represent a broad cross-section of academic practice and to facilitate my access to a group of specialist informants.

The journals were nominated by subject professionals as among the most important in their fields, and the articles chosen at random from issues published in 1997, taking care to select only those based on original data or new theoretical insights to allow a comparison of linguistic features.[2] The articles were scanned to produce an electronic corpus of just over 500,000 words after excluding abstracts and text associated with tables and graphics. In addition, I interviewed one experienced and well-published researcher from each discipline, typically an associate or full professor, about his or her own citation behaviours and their thoughts on disciplinary practices. The interviews were semi-structured and involved a series of open-ended interview prompts, which focused on their own and others' writing but allowed subjects to raise other relevant topics.

The corpus was computer searched for canonical citational forms such as a date in brackets, a number in squared brackets, and Latinate references to other citations (for example op cit, ibid.). This sweep left a number of citations unaccounted for however, particularly in the philosophy papers where renewed or extended discussion of a previously mentioned author often occurred without the repetition of a reference. A concordance was therefore made on all the names in the bibliographies of these articles, of third person pronouns and of generalized terms for agents, such as 'these researchers'. Possessive noun phrases such as 'Pearson's r' and 'the Raleigh-Ritz procedure' that did not integrate prior content were excluded, while those which legitimately referred to textual objects and attributed material to other sources (for example 'Gricean strictures', 'Davidson's argument') were counted. References to schools or beliefs, such as 'Platonists argue . . .', were only included if they referred to a specific author, as in 'Platonists like Bolzano argue . . .'. Finally, it should be noted that I am only concerned with references to the work of other writers in this paper and have excluded self-citation. The latter is far less central to academic argument than other-citation and, I suspect, differs considerably from it in terms of both motivation and disciplinary distribution.

Next I distinguished how authors were referred to syntactically and examined how citations were incorporated into the article, as quotation, summary or generalization from several sources. Finally I scanned the citations again to quantify the use of all main verbs associated with the authors identified through the above procedures, categorizing cases according to a modified version of Thompson and Ye's (1991) taxonomy of reporting verbs in article introductions. Note that in the following discussion I also adopt Thompson and Ye's useful convention of referring to the person citing as the 'writer' and the cited person as the 'author'.

General findings

The quantitative results show clear disciplinary differences, both in the extent to which writers rely on the work of others in presenting arguments and in how they choose to represent such work. Table 1 indicates the importance of citation in academic writing, with an average of almost 70 per paper, and also the degree of disciplinary variation. The figures broadly support the informal characterization that softer disciplines tend to employ more citations, with engineering and physics well below the average, although the frequencies for molecular biology appear to differ considerably from this general picture.

Table 1: Rank order of citations by discipline

Rank	Discipline	Av. per paper	Per 1000 words	Total citations
1	Sociology	104.0	12.5	1,040
2	Marketing	94.9	10.1	949
3	Philosophy	85.2	10.8	852
4	Biology	82.7	15.5	827
5	Applied Linguistics	75.3	10.8	753
6	Electronic Engineering	42.8	8.4	428
7	Mechanical Engineering	27.5	7.3	275
8	Physics	24.8	7.4	248
	Totals	67.1	10.7	5,372

Table 2 shows that there was far less variation in the ways disciplinary communities refer to sources, with all but philosophy displaying a distinct preference for non-integral structures.

Integral forms tend to give greater prominence to the cited author and only the articles in philosophy, which typically consist of long narratives that engage the arguments of other writers, consistently included the cited author in the reporting sentence:

(1) Davidson ascribes to Dewey the view that . . . (P5)
. . . some can be analysed in the manner suggested by Lewiss, . . . (P4)
Sherin (1990) argues that police agencies establish triage systems whereby . . . (S9)

In the physical sciences, of course, journal styles often require numerical-endnote forms, which reduces the prominence of cited authors considerably:

(2) However, as has been analysed in a recent paper [17] dealing with the spin-spin . . . (PY2)
The latter has been the subject of debate [13, 14]. (PY3)
Refs [12–19] work out the theory of spatial kinematic geometry in fine detail. (ME1)

Table 2: Surface forms of citations (%)

Discipline	Non-integral	Integral	Subject	Non-subject	Noun-Phrase
Biology	90.2	9.8	46.7	43.3	10.0
Electronic Engineering	84.3	15.7	34.2	57.6	8.2
Physics	83.1	16.9	28.6	57.1	14.3
Mechanical Engineering	71.3	28.7	24.9	56.3	18.8
Marketing	70.3	29.7	66.9	23.1	10.0
Applied Linguistics	65.6	34.4	58.9	27.1	14.0
Sociology	64.6	35.4	62.9	21.5	15.6
Philosophy	35.4	64.6	31.8	36.8	31.4
Overall Averages	67.8	32.2	48.3	32.7	19.0

Within integral sentences, greater emphasis can be given to authors by choice of syntactic position and, once again, there seems to be a broad division between the hard and soft disciplines with the former tending to favour reporting passive or adjunct agent structures (for example *according to* . . .). Philosophers once more differed in their greater use of noun phrases and possessive forms, which are often accompanied by more than a hint of evaluation:

(3) If I guess correctly that the Goldblach conjecture is true, . . . (P2)
We can usefully start with Stalnaker's pioneering sketch of a two-stage theory. (P1)
. . . according to Davidson's anomalous monism, our mental vocabulary . . . (P5)
. . . on a par with Aristotle's famous dictum that . . . (P8)

These forms are far less common in the sciences, and also differed in function, largely acting as shorthand references to procedures rather than a means of introducing an authors' work:

(4) The Drucker stability postulate in the large regains . . . (ME6)
Using the Raleigh-Ritz procedure, i.e. making it stationary with respect to . . . (PY4)
. . . are evaluated with 8 x 8 = 64 two dimensional Gaussian quadrature formula. (ME4)
Matthei's equations [17, 19] were first used as a starting point in the scale model . . . (E1)

In sum, we tend to find a marked overall disposition towards non-integral and non-subject citation forms in the science and engineering papers.

Another aspect of reporting that has interested researchers is how source material is used in the writer's argument (Dubois 1988; Thompson 1996). Clearly the ways writers choose to incorporate others' work into their own, ranging from extended discussion to mandatory acknowledgement, can have an important impact on the expression of social relationships in the collaborative construction of a plausible argument. Choices here largely concern the extent to which the report duplicates the original language event, the options being use of short direct quotes (three or more words), extensive use of original wording set as indented blocks, summary from a single source, or generalization, where material is ascribed to two or more authors.

A cursory analysis of half the articles in the corpus suggests little disciplinary variation in the treatment of imported messages. Table 3 shows that citations were overwhelmingly expressed as summary, with generalization comprising most of the rest. Direct quotation was minimal and did not occur in any science papers. These results are clearly related to the discoursal conventions of journals and the fields they represent, ultimately pointing to the persuasive purposes of academic citation in different traditions. The way information is presented is crucial in gaining acceptance for a claim and so writers will tend to express the original material in their own terms. This means employing the cited text in a way that most effectively supports their own argument. Summary and generalization are obviously the most effective ways of achieving this as they allow the writer greater flexibility to emphasize and interpret what they are citing. In most cases the original author's words are only likely to be carried into the new environment when writers consider them to be the most vivid and effective way of presenting their case.

Finally, I examined the choice of reporting verbs in the corpus. Over 400 different verbs were used in citations, although nearly half these forms

Table 3: Presentation of cited work (%)

Discipline	Quote	Block quote	Summary	Generalization
Biology	0	0	72	38
Electronic Engineering	0	0	66	34
Physics	0	0	68	32
Mechanical Engineering	0	0	67	33
Marketing	3	2	68	27
Applied Linguistics	8	2	67	23
Sociology	8	5	69	18
Philosophy	2	1	89	8

Table 4: Reporting forms in citations

Discipline	Reporting structures		Most frequent forms
	per paper	% of citations	
Philosophy	57.1	67.0%	say, suggest, argue, claim, point out, propose, think
Sociology	43.6	42.0%	argue, suggest, describe, note, analyse, discuss
Applied Ling.	33.4	44.4%	suggest, argue, show, explain, find, point out
Marketing	32.7	34.5%	suggest, argue, demonstrate, propose, show
Biology	26.2	31.7%	describe, find, report, show, suggest, observe
Electronic Eng.	17.4	40.6%	propose, use, describe, show, publish
Mechanical Eng.	11.7	42.5%	describe, show, report, discuss
Physics	6.6	27.0%	develop, report, study
Averages	28.6	42.6%	suggest, argue, find, show, describe, propose, report

occurred only once. The seven forms in the Averages row in Table 4 represent over a quarter of all citation forms used. The ratio of reporting/non-reporting structures was fairly uniform across disciplines, although philosophers tended to employ more report verbs and physicists used fewer. As can be seen, there were substantial differences between disciplines, in both the density of reporting structures and the choice of verb forms. The table shows an enormous variation between disciplines and suggests that writers in different fields almost draw on completely different sets of items to refer to their literature. Among the higher frequency verbs, almost all instances of *say* and 80 per cent of *think* occurred in philosophy, 70 per cent of *use* in electronics, 55 per cent of *report* in biology, and 53 per cent of *examine* in applied linguistics. Verbs such as *argue* (100 per cent of cases), *suggest* (82 per cent), and *study* (70 per cent) were favoured by the social science/humanities writers while *report* (82 per cent), *describe* (70 per cent), and *show* (55 per cent) occurred mainly in the science/engineering articles.

Following Thompson and Ye (1991) and Thomas and Hawes (1994), I classified the reporting verbs according to the type of activity referred to. This gives three distinguishable processes: (1) Research (real-world) Acts, which occur in statements of findings (*observe*, *discover*, *notice*, *show*) or procedures (for example *analyse*, *calculate*, *assay*, *explore*); (2) Cognition Acts, concerned with mental processes (*believe*, *conceptualize*, *suspect*, *view*); (3) Discourse Acts, which involve verbal expression (*ascribe*, *discuss*, *hypothesize*, *state*).

In addition to selecting from these denotative categories, writers also exploit

the evaluative potential of reporting verbs. The taxonomy employed here diverges from Thompson and Ye's rather complex system by eliminating the need to make fine distinctions between ten sub-categories of evaluation. Despite this simplification however, it does retain their insight that while all recording of sources is mediated by the reporter, writers can vary their commitment to the message by adopting an explicitly personal stance or by attributing a position to the original author. Thus, the writer may represent the reported information as true (*acknowledge, point out, establish*), as false (*fail, overlook, exaggerate, ignore*) or non-factively, giving no clear signal. This option allows the writer to ascribe a view to the source author, reporting him or her as positive (*advocate, argue, hold, see*), neutral (*address, cite, comment, look at*), tentative (*allude to, believe, hypothesize, suggest*), or critical (*attack, condemn, object, refute*). Figure 1 summarizes these denotative and evaluative options.

The quantitative analysis shows a fairly clear division in the denotative categories corresponding to the traditional division between hard and soft disciplines (Table 5). Philosophy, sociology, marketing, and applied linguistics largely favoured Discourse activity reporting verbs and the engineering and science papers display a preference for Research-type verbs. The evaluative verbs show broadly similar distributions, with verbs indicating the writer's belief in the factual status of a report (Factives) exceeded by those withholding judgement (Non-factives) in all disciplines. Only humanities/social science papers contained counter-factive examples, which represent information as unreliable. The presentation of non-factive material again revealed disciplinary distinctions with writers in the soft disciplines more likely to report authors as expressing either a positive or negative stance. Marketing writers employed a particularly high proportion of author tentative verbs, with *suggest* accounting for over half of all instances.

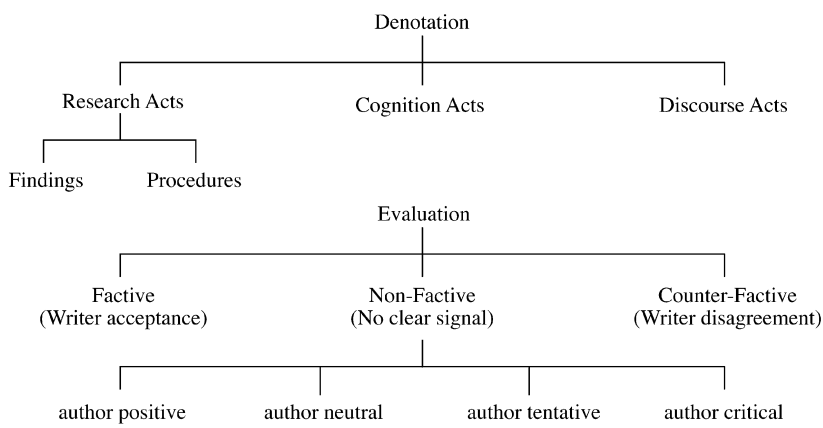

Figure 1: Categories of reporting verbs

Table 5: Classification of reporting verbs in corpus (%)

Denotation	Biology	Physics	Elec Eng	Mech Eng	Mkting	App Ling	Sociology	Phil	Totals
Research	43.1	56.0	55.2	47.0	31.2	30.5	29.1	23.5	33.5
Cognition	7.2	6.1	2.9	1.7	7.3	10.5	6.9	14.7	8.9
Discourse	49.7	37.9	41.9	51.3	61.5	59.0	64.0	61.8	57.6
Evaluation	**Biology**	**Physics**	**Elec Eng**	**Mech Eng**	**Mkting**	**App Ling**	**Sociology**	**Phil**	**Totals**
Factive	26.7	15.1	16.1	27.3	19.6	20.0	16.3	15.4	19.0
Counter-Factive	0.0	0.0	0.0	0.0	1.8	1.9	3.0	2.8	1.6
Non-Factive	73.3	84.9	83.9	72.7	78.6	78.1	80.7	81.8	79.4
author positive	16.7	8.9	8.2	8.2	29.2	32.2	30.1	31.0	25.7
author neutral	60.9	76.8	69.9	76.5	35.0	48.3	47.7	39.2	49.2
author tentative	22.4	14.3	21.2	15.3	33.5	17.6	16.8	21.0	21.1
author critical	0.0	0.0	0.7	0.0	2.3	1.9	5.4	8.8	4.0

DISCUSSION: CITATION AND DISCIPLINARY ARGUMENT

The extensive use of citation in this corpus underlines the fact that, in academic writing, the message presented is always embedded in earlier messages. But while all writers drew intertextual links to their disciplines, they did so to different degrees and in different ways, and these differences reflect clear disciplinary distinctions. The differences are meaningful because citation plays such an important role in mediating the relationship between a writer's argument and his or her discourse community. Differences in rhetorical conventions can therefore suggest characteristic variations in structures of knowledge and intellectual inquiry, the regularities pointing to 'stereotypical social actions' (Miller 1984) and offering insights into the knowledge-constructing practices of disciplinary communities. Broadly speaking, these differences correspond to the traditional distinctions between hard and soft disciplines (sciences/engineering and social sciences/humanities) (Becher 1989; Kolb 1981). Such distinctions cannot capture the full complexity of disciplinary differences, and may only be acceptable at a general level of analysis, but they do provide a useful basis for identifying dimensions of variability between these fields.

Reference to prior research clearly plays a more visible role in the humanities. Together the articles in philosophy, sociology, marketing and applied linguistics comprised two thirds of all the citations in the corpus, twice as many as the science disciplines. Writers in these fields were also more likely to use integral structures and to place the author in subject position, to employ direct quotes and discourse reporting verbs, and to attribute a stance to cited authors. Writers in the hard sciences on the other hand were, with the exception of biology, less extensive in their citation practices and tended to downplay the role of the author. In the remainder of this article I consider possible reasons for these differences, drawing on interviews with expert-writer informants to do so. I suggest that they are closely bound to the social activities, cognitive styles and epistemological beliefs of particular disciplinary communities.

Contextualization and the construction of knowledge

Cognitively it has been noted that a feature of hard knowledge is its relatively steady cumulative growth, where problems are typically seen as determined by the imperatives of current interests and new findings are generated by a linear development from an existing state of knowledge (Kolb 1981; Kuhn 1970). While perhaps an ideological artifact of practitioners, such ontological representations nevertheless have important epistemological and rhetorical consequences (for example Berkenkotter and Huckin 1995). My scientist informants, for example, saw themselves as inhabiting a relatively discrete and clearly identifiable area of study and their research as proceeding along well-defined paths. The conception that their work occurs within an

established framework of theoretical knowledge is reflected in scientists' routine discourse practices, as it means writers can presuppose a certain amount of background, procedural expertise, theoretical understanding and technical lexis (Bazerman 1988; Hyland, 1999). In particular, such shared assumptions allow research to be co-ordinated by reporting experiments using a highly formalized and standardized code in place of an extensive system of references to previous work.

This kind of direction and predictability is relatively rare in the humanities and social sciences however. Here new knowledge follows altogether more reiterative and recursive routes as writers retrace others' steps and revisit previously explored features of a broad landscape. In addition, issues are more diverse and detached from immediately prior developments (Becher 1989). Writers draw on a literature that often exhibits greater historical and topical dispersion, being less governed by current imperatives and less dependent on a single line of development. As my informants noted, in these circumstances research cannot be reported with the same confidence of shared assumptions:

> I often cite from social psychology or organizational behaviour and other fields that my readers may not be familiar with, so I need to build a basis for what I'm saying. I don't just have to show my reasoning is dependable but also that my scholarship is too. (M interview)

> I'm conscious that my work may be read by both academics and teachers and so I often lay out the background carefully. To fit maybe different audiences. (L interview)

More importantly, the literature is open to greater interpretation, findings are more frequently borrowed from neighbouring areas, and there are not the same clear-cut criteria for establishing or refuting claims. Together these differences mean that readers cannot be assumed to possess the same interpretive knowledge. Writers therefore often have to pay greater attention to elaborating a context through citation, reconstructing the literature in order to provide a discursive framework for their arguments and demonstrate a plausible basis for their claims. The more frequent citations in the soft texts therefore suggest greater care in firmly situating research within disciplinary frameworks and supporting claims with intertextual warrants.

These two broad conceptions of knowledge also result in different views about what constitutes a pertinent contribution and, indirectly, who can be cited. Scientific claims, if accepted, are generally regarded as discoveries that augment an orderly and coherent sequence of explanations in a given problem area, each fitting another block in the incremental completion of a research puzzle. This implies the assimilation of prior claims by new. As a result, a reader is unlikely to find Einstein, Oppenheimer, or Planck cited in a physics paper:

> This knowledge is assumed. It is not that we reject them but it is just well-known facts. My personal view of science is of a huge volcano and lava is flowing down and I'm at the end of one stream of lava. Nobody cites volcanoes in their papers. (PY interview)

Citation in the hard disciplines is therefore a means of integrating new claims into current knowledge while drawing on it as supporting testimony, situating the new work in the scaffolding of already accredited facts. References, particularly in physics, therefore tend to be tightly bound to the particular research topic under discussion (see also Bazerman 1988: 164), which closely defines a specific context of knowledge and contributes to a sense of linear progression. Intertextuality provides persuasive support by demonstrating the current work as 'valid science': the precedent providing a forceful warrant for current innovation. In the humanities and social sciences on the other hand, the fabric of established understandings has a wider weave. Problem areas and topics are generally more diffuse and range over wider academic and historical territory, and there is less assurance that questions can be answered by following a single path. Thus the substantial differences in citation rates between broad academic fields to some extent reflect the extent to which a context can be confidently assumed to be shared by readers. In soft domains, on the other hand, old ground is re-crossed and reinterpreted rather than suppressed.

The process of coming to terms with the complexity of human behaviour is perceived as less obviously progressive and therefore less likely to discard older ideas as obsolete or irrelevant. As my sociology informant observed, 'good theory doesn't date . . . Durkheim is a cottage industry. People promote or pan his ideas but he's still there because we can't say for sure whether he's right or wrong'. As a result, disciplinary giants are frequently encountered in the soft papers, particularly in 'pure' knowledge fields, where the pathfinders' stocks of relevance are clearly greater:

(5) . . . because it runs counter to the bureaucratic ideal of efficiency (for example Weber 1946). (S9)
Marx located barricades at the core of conspiratorial movements . . . (S7)
The first is derived from Durkheim's (1938) notion that there is a general . . . (S9)
However, both Piagetian and Vygotskian thinking involve constructivist . . . (L10)
Wittgenstein insists that what is true or false is what people say, . . . (PL5)
John Stuart Mill taught us to recognize that informal social pressure can restrict . . . (P10)
Aristotle had a point when he defined humans as language users. (P7)

Agency and epistemology in reporting

The quantitative findings presented above may also be explained in terms of disciplinary dispositions to either acknowledge or suppress the role of human agency in constructing knowledge. As noted above, what constitutes valid claims and admissible reasoning differs between disciplines, and these values and epistemologies are instantiated in aspects of a community's genre conventions. An important aspect of the positivist-empirical epistemology that characterizes a great deal of scientific endeavour is that the authority of the individual is subordinate to the authority of scientific procedure. While these procedures may often be named after their originators (see, for example, 4), this does not directly acknowledge the role of individuals in creating knowledge, but functions as an insider code to situate current work within a framework of shared methodological understandings.

Although many scientists may have perceived the achievement of absolute truth to be an illusory goal, their discursive practices are nevertheless guided by empiricist beliefs. Articles in the hard sciences still suggest that knowledge is accomplished by the correct application of prescribed procedures, and that nature reveals itself directly through scientific method. In this perspective human judgement as a mediating link in the interpretation of data is downplayed, descriptions of phenomena are depicted as representing a reality independent of the observer, and empirical methods are reified in the conventions of scientific narrative. Scientists act as if they see themselves as discovering truth, not making it.

The conventions of impersonality in science articles play an important role in reinforcing this ideology by portraying the legitimacy of hard science knowledge as built on socially invariant criteria. While seeking to establish their own reputations through publication and the recognition bestowed by citation, writers routinely (and often unreflectingly) also subscribe to the assumption that the person who publishes a claim is largely immaterial to its accuracy. The author is merely 'a messenger relaying the truth from nature' (Gilbert 1976: 285). This not only helps to account for the relatively low incidence of citation in the physics and engineering corpus, but also for the predominance of non-integral structures and perhaps also the overwhelming use of the footnote format:

(6) Silicon based methods (Buttenbach (1994)) as well as LIGA (Ehrfeld (1990)) are the major process families in this context. (E2)
Furthermore, it has been shown [103] that the fundamental dynamic range of . . . (E7)
As already observed by others [17], T1 was found to be . . . (PY3)
. . . power gradient linearity in Ref (1) may be partly due to the choice of target fields . . . (PY5)
. . . Melan theory exhibits the same conceptual structure as the classical one [1–3]. (ME6)

. . . has been summarized by various authors (2, 8, 16) and is still being re-analysed. (ME3)

The suppression of authors as agents has also blurred Swales' original integral versus non-integral distinction and led to the emergence of a variant form of reporting structure. Examples such as these are fairly common in the corpus:

(7) The angle x must be smaller than x/2 and is described by [3] (PY3)
According to ref. [11] the coupling parameters in the free electron . . . (PY1)
Ref. [9] developed finite formulations and corresponding code. (PY4)
. . . using the highly efficient techniques described in [22], [23], and [25]. (E3)
. . . properties of a line trajectory in spatial motion are researched by Refs [21-23], . . . (ME5)
Reference [20] presents a unified theory of kinematic synthesis to solve the problem. (ME2)
References [4, 5] reveal points with special kinematic meanings in the main body. (ME1)
Reference [6] shows a spatial Euler-Savaray analogue based on velocity and . . . (ME1)

While not all my scientist informants were comfortable with this hybrid pattern, its frequency testifies to a certain acceptability, particularly in physics and mechanical engineering. Its use also underlines the considerable variation in how reporting verbs are used in different disciplines.

Thus, together with relatively low citation rates and high use of non-integral forms, these kinds of patterns help to convey epistemological assumptions that give little space to those whose contributions are cited. Removing the agent helps remove the implication of human intervention, with all the influences of personal interest, social allegiance, faulty reasoning and other distorting factors beyond the empirical realm which that might suggest. These citation practices therefore help maintain the legitimacy of scientific knowledge as built on non-contingent pillars such as strict procedures, replication, falsification, and rigorous peer review in the process of publication.

Molecular biology, however, differs significantly from these fields. Although it is a 'hard' science, and presumably shares the ethos and commitments sketched above, it has the greatest density of citations in the corpus, with three times as many attributions as physics, and also the highest proportion of author subjects among the sciences. While the reasons for these differences are unclear, they appear to reflect the distinctive ways that biology pursues and argues problems and understands the scientific endeavour (cf. Chargaff 1974).

In many ways molecular biology is neither fully established nor

prototypically 'scientific'. It is a relatively new discipline, with perhaps less cohesive research networks, and its methods are more descriptive, relying to a greater extent on 'beautiful models' than either physics or chemistry (Kellenberger 1989). The personalities of biology, the creators of its speculations and discoveries, have also tended to assume greater importance than in other hard sciences, both inside and outside the discipline (Judson 1995; Watson 1968). Darwin, Bragg, Pauling, Luria, and Crick are perhaps among the most well known academics of any field. Halloran (1984) has argued that this is the result of an entrepreneurial spirit in the discipline, a notion of scientific knowledge as private property that originated with Watson and Crick's seminal 1953 paper that simultaneously offered a model of DNA and a model of the scientist:

> Both argumentatively and stylistically Watson and Crick put forward a strong proprietary claim to the double helix. What they offer is not *the* structure of DNA or *a* model of DNA, but Watson and Crick's structure or model. (Halloran 1984: 75)

The proclivity for citation in molecular biology, and for the exceptional scientific emphasis on integral reporting structures, might therefore be seen as an indication of a disciplinary ethos that emphasizes proprietary rights to claims. Admittedly this claim is purely speculative and more research is required to account for this difference. However, my data suggests that constructing knowledge in biology seems to involve rhetorical practices that give greater weight to who originally stated the prior work, rather than the traditional conventions of impersonalization still observed in the other hard disciplines studied here.

Writers in marketing also appear to give significant recognition to the ownership of ideas, with high levels of reporting, and subject position author names. A marketing professor admitted that there was a certain self-advocating tendency among practitioners, 'Some people really promote their work and the area of research that they are in, both behind the scenes and in their papers.' While it is difficult to draw strong connections, this may be related to the involvement of large numbers of marketing academics in corporate consultancies, a source of increasing influence on research. 'A lot of the research we do comes from real-world or corporate problems and even if it doesn't originate there, the ultimate goal is that it should end up there' (M interview). Such dual interests increase the possibility of overlap between research and commercial values, with attribution practices becoming influenced by the norms of ownership and competition more typically associated with the marketplace.

The effects of professional and workplace contexts on academic literacy practices are largely unknown, but are clearly pertinent. Writing is collective, co-operative persuasion and occurs within communities bound together by shared assumptions about the nature of the world, how to hold ideas, and how to present them to peers. This social basis of knowledge means its

authority originates in the groups who comprise the audience for texts, who both shape this knowledge and render it intelligible. The participation of academics from applied fields such as engineering, applied linguistics, and marketing in their respective public arenas of communication is therefore likely to have consequences for their discursive behaviours. Academic 'forums of competition' (Toulmin 1958), within which new concepts are appraised, become blurred with those of a more applied orientation as members are influenced by the problems, procedures, and criteria of evaluation which emerge from, and are relevant to, workplace concerns and practices. The effects of such interactions on citation conventions remains to be studied.

Another discipline with high author visibility is philosophy, where citation plays a very different role to the one it plays in the hard sciences. Here knowledge is constructed through a dialogue with peers in which perennial problems are recycled through personal engagement:

> Citing allows you to debate with others, the questions have been around a long time, but you hope you are bringing something new to it. You are keeping the conversation going, adding something they haven't considered. . . . You know most of them anyway, you read them and they read you. (P interview)

Bloor (1996: 34) refers to philosophical rhetoric as essentially 'mind-to-mind combat with co-professionals', and the extensive use of citation helps to achieve this high degree of personal involvement among protagonists. Many citations are thus repeated references in a protracted debate or draw on the reader's shared knowledge of an author's views without referring to a specific text. To emphasize the immediacy of the argument and its relevance to current concerns, they are usually presented in the present tense. These few random extracts give some flavour of this:

(8) I disagree sharply with Rawles on the matter of . . . . (P10)
My main critique of Maudlin's solution is that . . . (P6)
Nor can I see how Donnelan's syntactically simpler paradigm and my (for example 3) differ . . . (P1)
Davidson and Wittgenstein are alive to this possibility. (P5)
I have focused on Smith's formulation of the revised sceptical hypothesis . . . (P3)

This conventional dispute structure often goes beyond the writer's response to the paraphrased arguments of an adversary to an imagined dialogue where claims are provided on their behalf. In the absence of an actual counter-argument, philosophers may strengthen their position by inventing one and attributing it with a hypothetical citation:

(9) It might be suggested (perhaps by someone like René Descartes) that the problem . . . (P2)
Wittgenstein would argue that this term expresses . . . (P5)

> Now Rawls could say that his concern, too, is distributive justice . . . (P10)
> If Churchland intends to say that . . . (P7)

Clearly these citation practices are not supporting the writer's claim to be extending the thread of knowledge from what has been previously established, but helping to position the writer in relation to views that he or she supports or opposes. Scollon (1994) has argued that citing the work of others is not simply an issue of accurate attribution, but also a significant means of constructing an authorial self. Writing in the humanities stresses the individual creative thinker, but always within the context of a canon of disciplinary knowledge. Foregrounding the names of those whose work we engage with enables us to establish a professional persona. This was mentioned explicitly as a reason for citing by the sociologist:

> I've aligned my self with a particular camp and tend to cite people from there. Partly because I've been influenced by those ideas and partly because I want them to read my work. It's a kind of code, showing where I am on the spectrum. Where I stand. (S interview)

Ethos and evaluation: the use of reporting verbs

The distribution of reporting verbs in the corpus also reveals broad disciplinary differences. There appear to be community-based preferences, both for specific items and the implications carried by particular semantic categories. While more work needs to be done in this area, it is possible that these choices serve to reinforce the epistemological and social understandings of writers by conveying an orientation to a particular ethos and to particular practices of social engagement with peers.

The finding that the humanities and social science articles contained far more, more varied, and more argumentative reporting verbs is partly a function of their greater need to elaborate a shared context. As discussed above, research in any field has significance only in relation to an existing literature, and citation helps demonstrate accommodation to this community knowledge. In the soft fields, convincing readers that an argument is both novel and sound may often depend on the use of reporting structures not only to build a shared theoretical basis for one's arguments, but to establish a common perspective on the reliability of the claims one reports. Writers have to construct an epistemic as well as a disciplinary context. The different epistemological structure and social organization of the hard sciences on the other hand often allows writers to assume more common ground with readers, requiring less need to demonstrate the relevance and reliability of prior studies using reporting verbs.

In addition to a heavier rhetorical investment in contextualization, the greater use of reporting verbs in the soft fields also reflects the more discursive character of these disciplines. Briefly, reporting verbs are more appropriately

employed in an argument schema that more readily regards explicit interpretation, speculation and complexity as legitimate aspects of knowledge. The soft disciplines typically examine relationships and variables that are more numerous, less easily delineated and more subject to contextual and human vagaries than those studied in the hard sciences. Causal connections, conclusive demonstration, and depictions of feature are less easily established in the humanities (Kolb 1981). One reason for the use of a wider repertoire of citation verbs therefore is simply that they facilitate qualitative arguments that rest on finely delineated interpretations and conceptualizations, rather than systematic scrutiny and precise measurement. What appear at first sight to be stylistic proclivities for uniform choices in the hard sciences then, may actually reflect the different procedures, subject matter, epistemological understandings and research perspectives that characterize those fields.

The scientific ideology that perceives laboratory activity as impersonal, cumulative and inductive also helps to explain the relatively high frequency of Research verbs found in the science/engineering corpus. These comprised about half of the denotation choices in biology, physics, and the engineering disciplines, and between a quarter and a third of those in the soft disciplines. This emphasis on real-world activities helps to convey the experimental explanatory schema typical of the sciences, where knowledge is more likely to be represented as proceeding from laboratory activities than the interpretive operations or verbal arguments of researchers.

(10) Edson *et al.* (1993) showed processes were induced only after the cells were treated . . . (B1)
. . . linear and non-linear distraction observed in LC delay lines [2]. (E7)
a 'layer' coupled-shot finline structure was studied by Mazur [7] and Tech *et al.* [8] . . . (PY4)
. . . using special process and design [42], or by adding [101], or removing [83] a mask. (E7)
References [7, 8] developed instantaneous invariance via point coordinates for the . . . (ME1)

This emphasis was particularly evident in the physics and engineering papers, which together contained only nine cognition verbs, thereby camouflaging the role of author interpretation in the research process. Applied linguistics and, in particular, philosophy, however, used such verbs extensively, underscoring the part that reasoning and argument play in the construction of knowledge:

(11) Acton (1984) sees preparing students psychologically as a . . . (L4)
Parry concluded that by reading less, this student was encountering fewer new words . . . (L2)
Some writers, for example Adams (2) think that . . . (P4)

Donnelan believes that for most purposes we should take the demonstratum to be . . . (P1)

Report verbs however do not simply function to indicate the status of the information reported, but the writer's own position in relation to that information. The selection of an appropriate reporting verb allows writers to intrude into the discourse to signal an assessment of the evidential status of the reported proposition and demonstrate their commitment, neutrality or distance from it. There was, however, little difference in how writers used verbs from the major categories in this corpus, although only soft disciplines employed counter-factive verbs, representing reported material critically:

(12) His revisionist interpretation of Twiggy overlooks historical research . . . (M8)
In addition, he fails to fully acknowledge the significance of . . . (S4)
Lillian Faderman has also probably exaggerated the pervasiveness of . . . (P5)
Churchland did not simply misuse the word 'theory'. (P7)

Generally writers in all fields tended to indicate their positions to cited material more indirectly, by ascribing an attitude to authors. These imputed positions showed clear disciplinary variations, with scientists and engineers overwhelmingly representing authors as conveying a neutral attitude to their findings. This conveys a detached and impartial reporting style to these papers, reflecting the need to build a convincing argument by simply displaying an awareness of prior or parallel research without appearing to corrupt it with personal judgement:

(13) . . . the relevant theory was developed by Bruno [11]. (PY1)
These ornamentations were described by Schenck *et al.* (1984) as . . . (B2)
Yeh *et al.* [7] reported that a typical force . . . (E5)
. . . other solutions have also been published [5–7] (E6)
Paiva and Venturinit (9), presented an alternative formulation . . . (ME4)
At Liverpool, simulated seismic tests have been performed on plain pipes [9] . . . (ME3)

Writers in the soft disciplines on the other hand were far more likely to depict authors as adopting a particular stance towards their work, either presenting their view as true, false or tentatively correct:

(14) Baumgartner and Bagozzi (1995) strongly recommend the use of . . . (M9)
Law and Whitley (1989) argued, for instance, that . . . (L7)
However, both Davidson and Wittgenstein explicitly disown the view . . . (P5)
. . . the idea of a characterless substructure is rejected by

Aristotle in *Metaphysics*. (P6)
Tarone (1978) suggests that there is . . . (L4)
Kubiak hints that the Polish tradition . . . (S3)

They were also more likely to evaluate this attributed position by adding adverbial comment, although this was not common and was largely restricted to philosophy:

(15) He argues there, correctly to my mind, that . . . (P2)
Churchland correctly rejected this move . . . (P7)
As Dipankar Gupta correctly asserts . . . (S3)

Clearly these explicitly evaluative strategies are better suited to the more disputational style of argument favoured by the humanities, as they allow writers to open a discursive space within which to either exploit their opposition to the reported message or to build on it. Establishing intertextuality by attributing a view to another also allows this to be done in a dialogic way, by engaging the scholarship of the discipline through a discourse with those who have created it. Once again, then, we find that textual conventions point to distinctions in how knowledge is typically negotiated and confirmed within distinct academic communities, facilitating the different ways writers are able to link their local contributions into a wider disciplinary framework of expectations.

CONCLUSION

Reference to previous work is virtually mandatory in academic articles as a means of meeting priority obligations and as a strategy for supporting current claims. But how writers choose to present information is as important as the information they choose to present. The disciplinary differences discussed here suggest that the imperatives that motivate citations are contextually variable and are related to community norms of effective argument. The fact that academics actively engage in knowledge construction as members of professional groups means that their discoursal decisions are socially grounded, influenced by the broad inquiry patterns and knowledge structures of their disciplines. How an academic community defines its field of inquiry and understands the material it investigates, the ways it conceptualizes and tackles research issues, and the metaphors it employs to characterize knowledge, are all matters of social agreement or contestation. They also contribute to how writers choose to frame their studies for colleagues, relying on a sprinkling of citations to invoke a set of common understandings through to an elaborate scaffold of supporting references.

Such practices cannot, of course, be seen as entirely determined, language users are not simply passive recipients of textual effects. But the impact of citation choices clearly lies in their cognitive and cultural value to a community, and each repetition helps instantiate and reproduces these

conventions. The broad distinctions explored in this article therefore provide further support for the view that our routine and unreflective writing practices are deeply embedded in the epistemological and social convictions of our disciplines.

Finally, the study has both raised and neglected a number of issues that provide fruitful ground for further research. Clearly there are attribution practices in other disciplines and genres that we know little about, and it is also probable that closer analyses will reveal variations in sub-genres and sub-disciplines. The comparative study of citation patterns in theoretical and experimental papers, for example, or of established and emergent fields within a discipline, may reveal interesting differences. Similarly, the study of self-citation and how it interacts with both other-citation and writer purposes is likely to be profitable. A further important area that I have not addressed concerns the conventions used to interpret citations, particularly the degree of community or individual variation in determining their scope and specificity.[3] Exactly what part of a proposition is a particular citation understood to refer to? What interpretive understandings do community members employ in their readings of cited material? Are there contextual variations in the licence granted to writers in representing prior work? These questions not only suggest intriguing areas of future study, but may help us to sharpen our understanding of how discourse practices contribute to the construction of academic knowledge.

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APPENDIX. JOURNAL CORPUS

Applied Linguistics (L)

1. *Applied Linguistics*
2. *TESOL Quarterly*
3. *Second Language Research*
4. *System*
5. *English for Specific Purposes*
6 *World Englishes*
7. *Journal of Second Language Writing*
8. *Journal of Pragmatics*
9. *Written Communication*
10. *International Journal of Applied Linguistics*

Electronic Engineering (E)

1. *Int J. of Microwave and Millimeter-Wave CAE*
2. *Microsystem Technologies*
3. *IEEE Transactions on Microwave Theory and Techniques*
4. *Journal of Microelectromechanical Systems*
5. *Solid-state Electronics*
6. *Microelectronics Journal*
7. *Analog Intg. Circuits and Signal Processing*
8. *J. of Manufacturing Science and Engineering*
9. *International Journal of Production Research*
10. *International J. of Industrial Engineering*

Mechanical Engineering (ME)

1. *Mechanism and Machine Theory*
2. *Energy Sources*
3. *J. of Process Mechanical Engineering*
4. *Mechanics and Material Engineering*
5. *Journal of Engineering Manufacture*
6. *Int. J. of Mechanical Sciences*
7. *J. of Mechanical Engineering Science*
8. *Energy Engineering*
9. *International J. of Energy Research*
10. *J. of Energy Resources Technology*

Marketing (M)

1. *Journal of Marketing Management*
2. *International Journal of Research in Marketing*
3. *Journal of Marketing Research*
4. *Journal of Marketing*
5. *Journal of the Academy of Marketing Science*
6. *Journal of Marketing Communication*
7. *Journal of International Consumer Marketing*
8. *Journal of Consumer Research*
9. *Journal of Retailing*
10. *Marketing Science*

Philosophy (P)

1. *Mind*
2. *The Journal of Philosophy*
3. *Analysis*
4. *The Philosophical Quarterly*
5. *Philosophy*
6. *Erkenntnis*
7. *Inquiry*
8. *Political Theory*

9. *Ethics*
10. *Philosophy and Public Affairs*

Cell and Molecular Biology (B)

1. *Journal of Cell Biology*
2. *Mycological Research*
3. *The Plant Cell*
4. *Plant Molecular Biology*
5. *Plant, Cell and Environment*
6. *Molecular and Cellular Biology*
7. *Mycologia*
8. *The New Phytologists*
9. *Canadian Journal of Botany*
10. *Plant Physiology*

Sociology (S)

1. *American Journal of Sociology*
2. *The Sociological Review*
3. *Current Sociology*
4. *International J. of Comparative Sociology*
5. *Sociology*
6. *International Sociology*
7. *British Journal of Sociology*
8. *British Journal of Criminology*
9. *Criminology*
10. *International J. of the Sociology of Law*

Physics (PY)

1. *J. of Magnetism and Magnetic Materials*
2. *Bulletin of Magnetic Resonance*
3. *Applied Magnetic Resonance*
4. *Electromagnetics*
5. *J. of Magnetic Resonance (B)*
6. *J. of Electromagnetic Waves and Applications*
7. *Journal of Material Science*
8. *Journal of Applied Physics*
9. *Physical Review B*
10. *American Journal of Physics*

NOTES

1 Examples and interviews are coded as P = Philosophy, S = Sociology; M = Marketing; L = Applied Linguistics; ME = Mechanical Engineering; E = Electrical Engineering; PY = Physics; B = Biology.

2 I should emphasize here that the analysis is cross-sectional rather than longitudinal, and culturally specific rather than comparative. It offers a snapshot of current practices of writers publishing in English and, while I readily acknowledge the historical and cultural limitations of this snapshot, the data allows me to say little about publishing practices at other times or in other cultures.

3 I am grateful to one of the anonymous reviewers for this point.

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