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SEMIOTICS AND EVALUATIVE BIBLIOMETRICS

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The reciprocal relationship between bibliographic references and citations in the context of the scholarly communication system is examined. Semiotic analysis of referencing behaviours and citation counting reveals the complexity of prevailing sign systems and associated symbolic practices.

SIGNS

Identifying, classifying and interpreting 'sign actions' [1, p. 4] are the constitutive tasks of semiotics – the science of signs. Within the world of scholarly communication, the dispensing of bibliographic references and the statistical manipulation of citations are established practices which invite semiotic analysis. What, after all, are references and citations if not signalling devices? This obvious fact is all too easily overlooked. Cronin [2, p. 16], for instance, has spoken of citations as 'frozen footprints in the landscape of scholarly achievement … which bear witness to the passage of ideas', but makes no explicit mention of semiotics or sign systems in discussing the need for a theory of citation. Many writers also use the terms 'reference' and 'citation' interchangeably, believing that the difference between the two is 'hardly relevant for anyone but he [*sic*] who is inherently meticulous' [3, p. 10]. Put simply, an author provides a reference and receives a citation. In fact, the distinction is anything but trivial. The purpose of this article is to explicate the reciprocal relationship between references and citations and to show how semiotics can contribute to the ongoing debate on the role and significance of citations in the primary communication system [4].

POLYSEMY

Bibliographic references are a way of denoting specific texts. The embedded reference in a scholarly text is a pointer to the full bibliographic record at the end of the paper, which itself is a pointer to the monograph or article in question. Ostensibly, a reference is a signalling device, a way of communicating to the reader that the author is familiar with, and has drawn upon, the work of another. Of course, referencing can also be interpreted as a strategising device [5], a means of locating one's thesis in a particular intellectual milieu, or, less charitably, as an attempt to imply some degree of social familiarity or celebrity endorsement. Multiple interpretations of references and their extra-textual import are possible.

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The patterning of references throughout a journal article testifies to a web of connections between the cited and citing authors' works: they reveal 'a trace of conversations between texts' [6, p. 63]. Such invocation is typically assumed to imply a degree of cognitive correspondence, ideational interplay, between the referencing and cited texts. What that is, how it is apprehended and used by others, and whether the assumption itself is valid remain contestable issues. And herein lie the fundamental problems associated with both referencing practices and citation counting – semantics and intentionality.

Like references, acknowledgements also testify, or point, to cognitive influences, but, additionally, they may bear witness to technical, procedural, moral and financial support proffered by myriad individuals and institutions. There are important differences, though [7, p. 21]:

> Both citations and acknowledgements declare a relationship … which may be profound or superficial. One, the citation, has objective status in that a third party can refer to the cited document and corroborate the citing author's interpretation, pursue an intellectual lead, or chain backwards or forwards through the related literature; the other, the personal acknowledgement, describes an inherently private interaction, or debt, which, by definition, cannot have the same commodity status.

References and acknowledgements, along with citations, are first cousins in an extended family of scholarly signs.

This family of signs (references, acknowledgements, citations) may soon have to accommodate additional kinds of signalling behaviour. The web is giving rise to new modes of communication, representation, recommendation and invocation. The ways in which, and reasons why, individual researchers and scholars are mentioned, or linked to on the web, are multifaceted. It is conceivable that novel forms of signalling will evolve, which could also be used as indicators of cognitive or social influence within specific disciplines or communities of professional practice. The potential significance of these different modes of invocation is a subject deserving of investigation and constitutes a logical progression of research and theorising into the epistemological and normative bases of referencing behaviour [8, 9].

RECIPROCAL RELATIONSHIP

Wouters [10, p. 7] has grasped clearly the nature of the reciprocal relationship between references and citations:

> In summary, the sign <reference> is a pointer belonging to the citing text. It points to the cited text but is still an attribute of the citing text. The sign <citation>, however, constructed by inverting the reference, is an attribute of the cited text. The cited text is the (absent) referent of the scientometric citation. Thus the two have different referents and can consequently best be analysed as two different signs.

More recently, he has characterised the relationship as follows [3, p. 233]:

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> If reference R of citing article A points at article B, the corresponding citation C is initially nothing else than a different format of reference R. The citation is the mirror image of the reference. This rather innocent looking inversion has important consequences. By creating a different typographical format of the lists of references – by organizing the references not according to the texts they belong to, but according to the texts they point at – they become attributes of the cited instead of the original, citing texts.

The need for disambiguation will become clear in the sections which follow.

What do references mean when they are inverted and redesignated as citations? Typically, they are interpreted as records of intellectual trading, or as evidence of peer interactive communication [e.g. 11] which testify to instrumental, or other kinds of influence. Converted into citations, counted and analysed, they are widely held to be measures of cognitive impact, indicators of perceived utility or surrogate measures of academic quality. Are they some or all of these things, in some or all contexts, at some or all times? In reviewing the literature, one is struck by the degree to which a variety of social practices and associated explanations have been confounded and also by the extent to which mutual incomprehensibility and distrust seem to characterise the debate between proponents and opponents of citation analysis [12, 13].

There is a strong preference for metaphorical explanations (e.g. 'scholarly bricklaying' [14, p. 64]) and many writers exhibit a seeming inability to distinguish between references, acknowledgements and citations, as Egghe and Rousseau [15] have noted. How do we deal with the fact that references can have multiple articulations, that they function as signs which afford 'interpretative flexibility' [10, p. 7]? What does it mean to be heavily cited and, conversely, what does it say about a scholar whose work is uncited? What cultural meaning is ascribed to citedness, and does this vary across disciplines and communities of practice over time? These are important questions, and the problem is magnified when aggregations of citations are analysed and used as the basis of institutional or individual evaluation, a now fairly commonplace, though by no means universally welcomed, phenomenon in the higher education and science policy communities.

Although the figures vary from discipline to discipline, it is generally the case that a significant number of published papers are not cited within their first five years [16]. In that sense, citation analysis privileges a minority of published journal articles. Every paper is a reference waiting to happen: once activated (i.e. referenced), that paper acquires a polyvalent semiotic character. It is both the object pointed to by the textual reference and an indicator of presumptive influence; it is both sign and symbol. These indicators of influence are selectively marshalled in the form of the *Science Citation Index* (*SCI*), and its sister products, to create a cumulating ledger of scholars' symbolic market worth. The relatively recent epiphenomenon of citation has generated an industry of its own. In short, a communicative convention has undergone progressive commodification. How and why has this come about?

SIGN SYSTEMS

Gluck [17] has shown how semiotic analysis could be used to inform our understanding of information behaviours, using Peirce's sign triad (sign-vehicle,

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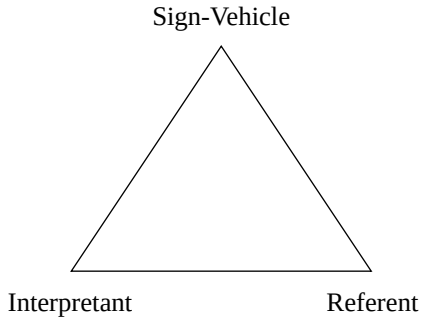

Figure 1. *Peirce's sign triad (after Gluck, [17])*

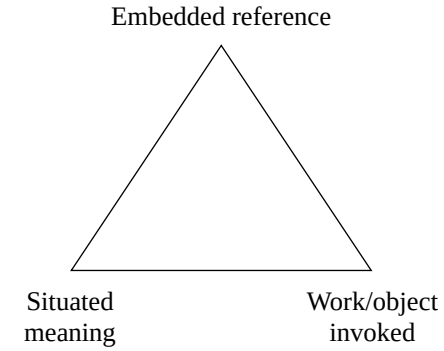

Figure 2. *Bibliographic reference sign triad*

interpretant, referent) as his root typology (Figure 1). Although alternative formulations and terminology are possible [e.g. 18], as he notes, this triad will allow us to examine references and citations in terms of three common dimensions: (i) the carrier of meaning (sign-vehicle); (ii) the meaning or concept referred to (interpretant); and (iii) the object pointed to (referent). How, then, do these elements reveal themselves with each class of sign – reference, acknowledgement, citation? Figures 2–5 demonstrate the distinctiveness of the various sign systems at work, and underscore the need for requisite interpretative variety and expositional clarity.

In Figure 2, the embedded reference is the sign-vehicle. It has dual referents – the full bibliographic reference at the end of the paper and the object for which that reference is a surrogate, the quoted work. The interpretant is the meaning or concept flagged by the sign-vehicle. It may be clearly grounded (for example, a formula is quoted) or ambiguous (a global reference is provided to an individual's *œuvre*).

In Figure 3, we can see that the referent of an acknowledgement statement is an interaction or event of some kind which involved the author and another social actor. This referent lacks the objectified (verifiable) status of the referent in Figure 2, but the debt it records (the interpretant in this instance) may be as important as that implied by a bibliographic reference.

The picture is different with respect to the citation. In this case (Figure 4), the sign-vehicle is found in the Institute for Scientific Information's (ISI) *Science*

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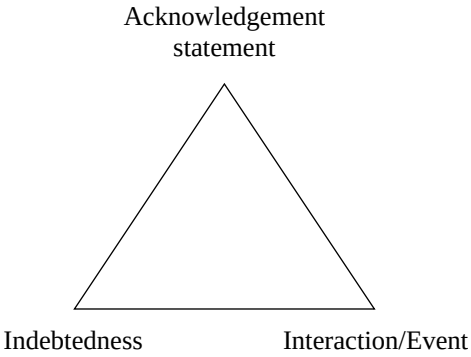

Figure 3. *Acknowledgement sign triad*

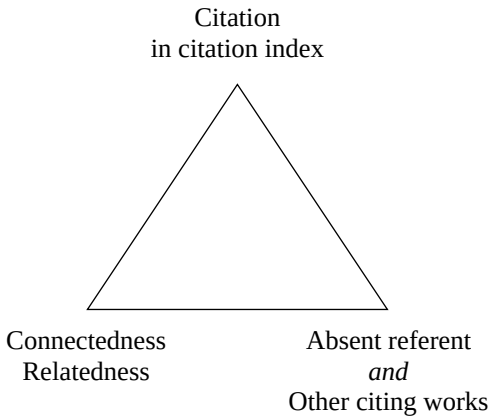

Figure 4. *Citation sign triad*

Citation Index and detached from its referent, the paper which it denotes and the related content. As Wouters [3, p. 11] observes, the 'basic function of the *Science Citation Index* (and similar devices) is to turn an enormous number of lists of references upside down'. The citation in fact has multiple referents, namely all the papers (objects) which the *SCI* lists as having invoked it. The citation points back to its parent article and forward to the population of papers which have referenced it over time. Its referents are multiply articulated. The meaning of these signs is best understood in terms of the intertextual relationships posited between the citing and cited papers and in the social networks and maps of science which they make manifest.

When aggregations of citations are analysed, the picture changes yet again (see Figure 5). In this case, the interpretant is typically expressed in terms of impact, worth or esteem, while the referent becomes the author. In evaluative bibliometrics, the focus is much more likely to be highly cited authors than their published works. As far as acknowledgements are concerned, there is at present no commercial equivalent of the *Science Citation Index*, though the idea has been suggested and a design blueprint proposed [19].

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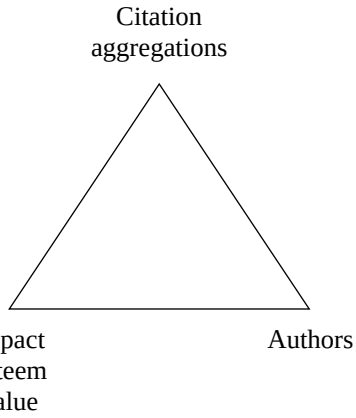

Figure 5. *Commodified citation sign triad*

SIGNIFICANCE

The relationship between sign and object can be difficult to pin down: sometimes the bibliographic reference may be pointing to an author's *œuvre* (the writings of Freud), sometimes a particular opus (Meadows' review article), sometimes a motif or theme (redemption in Wagner), sometimes a particular segment of a paper (the methods section), or sometimes a quantum (a proof, motif). Intuitively, there are various levels or gradations of referencing, ranging from the sub-atomic through molecular to compound [20]. However, textual analysis may not lay bare the exact relationship between the cited and citing texts. The MacRoberts [21, p. 156] have argued that many references simply do not register with the cited work, i.e. the degree of perceived fit, or relevance, is minimal or non-existent. This leads them to conclude that citation analysis is prone to systematic bias.

The MacRoberts [22] subsequently identified and classified discrepancies between influence as evident in a set of fifteen papers dealing with the history of genetics and influence as captured in the bibliographies attached to those papers. In their expert judgement, authors were seriously under-referencing sources of influence: on average the authors whose works they scrutinised achieved only 30% coverage of material influences. However, as Grafton [23, p. 18] notes, 'a historical work and its notes can never, in the nature of things, reproduce or cite the full range of evidence they rely on', a view shared by Merton [24, p. 84]: '*By itself*, citation analysis cannot trace all the complex sources of cognitive influences upon a particular work since *explicit citations*, which are ordinarily the only kind entered into quantitative citation analyses, do not adequately reflect the story … A fine-grained analysis would have to be supplemented by focused interviews with scientists reporting on contexts of what they have set in print'.

Referencing is a complex phenomenon which can be analysed in terms of a set of sign systems, as Figures 1–4 seek to make clear. Furthermore, referencing and citation behaviours vary within and between disciplines, such that blanket criticism is misplaced. And even if it were possible to make visible all influences, formal and informal, who is to say that author A rather than B should have been invoked at any given point? Who can say, with authority, whether my reception

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of, negotiation or interaction with another's text is right or wrong, appropriate or inappropriate? What matters is that I have chosen to reference A rather than B. It is an affirmation, a form of voting [13, 25], which ought not to be judged on a scale of objective relevance. This raises a number of key questions: why do authors vote the way they do, why are certain signs preferred over others, and what, in fact, is being signified?

COMMUNICATION AND CONVERSATION

The fact that there are gaps in our knowledge of authors' motivations does not mean that referencing behaviours lack uniformity or are fundamentally haphazard. The weight of empirical evidence suggests that authors reference the works of their peers in a serious and normatively-guided manner, and that these signs (references) perform a mutually intelligible communicative function [13]. Either we have to assume that authors are engaged in repeated acts of whimsy, which just happen to be overlooked or go undetected by those responsible for quality control in the primary communication system – a curiously baroque hypothesis – or we have to conclude that the reasons why, and ways in which, authors invoke the works of other authors have become, in Merton's [24, p. 48] words, 'normatively operative in modern science'.

If we accept that writing is a social act like a conversation, with rules for conversing [26, p. 4], then the nuances with which these conversational cues and clues are imbued will be lost once they are wrested from their conversational scaffolding, like words repeated out of context and out of sequence by an uninformed third party. Czarniawska-Joerges [6, p. 52], in fact, speaks of referencing as 'a special mode of conversation with rules of its own'. Over the course of the last century, these literary inscriptions have become indispensable features of any text with pretensions to scholarly status. But they have also taken on a shadow life as signs of esteem or prestige, and have become, to quote Bourdieu [27, p. 76], 'the most objectified of the indices of symbolic capital' within the modern academic world.

CONCEPT MARKERS

In order to understand fully the social significance of referencing, it is important to examine the production processes and consumption practices associated with these signs, and how the meanings we attribute to them can vary under different conditions and also from discipline to discipline. More specifically, we should consider how a fairly recently evolved social practice (formal bibliographic referencing) has undergone rapid institutionalisation and industrialisation. The development of commercial citation indexes has given rise to the academic equivalent of the *Financial Times Index*, from which the citation performance of institutions and individuals can be tracked. League tables, based on raw or weighted citation scores, can now be generated on demand by the ISI's research department. Even if we never reach the point when an individualised personal citation summary is available at the touch of a button [28], the trend to commodification, and the implications thereof, are clear.

The idea behind citation indexing is very simple: collect, organise and make available in machine readable form all bibliographic references from articles in

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reputable scholarly journals and allow users to search the database for those articles/authors which/who are pointed to with relatively high frequency on the not unreasonable assumption that frequency of mention has something to do with perceived utility or impact. But what happens to these signs (the references) when they are dereferentialised, lifted from their natural settings and homologised in the interests of convenience calculus – transmuted into the convertible currency of the citation? What, in other words, is lost, traduced or falsely assumed in the translation, an issue foregrounded by Warner [29, p. 28] in an early essay on the intersection of semiotics and information science?: '… the ambiguity of citations in aggregate form can be seen as a special case of the indeterminacy other written signifiers, such as words, can acquire when torn from their discursive context'. Unfortunately, Warner, like many others, has apparently failed to grasp the fact that references and citations need to be unravelled in terms of their respective sign systems (Figures 2, 4 and 5) if progress in terms of theory building is to be achieved.

Most certainly, references should not be dismissed as mere meta-textual baubles or tools of persuasion [e.g. 30]. Small [31] has shown that in some subject domains, for instance chemistry where terminology is 'hard', the embedded reference has a clear referent. Specifically, he talks of citations as markers or symbols which denote 'specific concepts or methods for particular disciplinary or speciality groups' [32, p. 187]. On examining fifty of the most highly cited chemical papers, he found that 87% of the authors referencing those documents were citing them for the same reasons and using almost identical terminology when citing them. This suggests extremely tight coupling between signifier and signified, a view endorsed by Van Raan [33]. But, as Small concedes, what holds for a selective population of experimental and theoretical chemistry articles is unlikely to hold for other fields, in which terminology, referencing styles and world views may be much looser. As a general rule, the interpretant will be more or less clear-cut depending on the nature of the discipline and the role of references therein.

REFERENCING AND READER RESPONSE

The residual subjectivity of referencing behaviour raises questions relating to the construct validity of citation analysis and evaluative bibliometrics. For a vocal minority, citation counting and ranking amount to little more than numerology, with citations being 'fetishised and turned into a highly desirable and marketable commodity' [34, p. 483]. Without reliable knowledge of why an author references the work of another, assumptions about the full communicative import of such signs are open to question. That, necessarily, raises concerns as to the validity of treating all citations as unitary equivalents which can be bundled together and statistically manipulated to make judgements about the relative research performance of individual scholars, project teams, institutions or nation states. However, the *reductio ad absurdum* of the radical interpretivist position is to deny the sociometric and information theoretic significance of referencing praxis.

Reader response theory offers an alternative perspective. A central problem with citation analysis is held to be the unknowability of the motivations which shape authors' sign actions. Small's [31, 32] work notwithstanding, there are also legitimate questions to be raised regarding the meaning readers extract from references – the flip side of the interpretative coin. Granted certain elements of the

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sign have formal or objective properties (the cited author's name, journal title, date of publication, publisher, broad subject matter, etc.), but readers, even if belonging to the same interpretative/discourse community, may decode aspects of these signs, and their referents, differently – the 'mirage of the referent', in Baudrillard's [35, p. 150] apt phrase. The possibility of noise arising at both the sender end (multiple motivations) and receiver end (multiple interpretations) of the communication spectrum is real. But that does not require us to conclude that all references are, to paraphrase Fish [36, p. 44], 'equally and radically orphaned in the sense that no one of them is securely fastened to an independently specifiable state of affairs'. And it certainly has not deterred proponents of evaluative bibliometrics from imbuing these signs with considerable symbolic import.

SYMBOLIC CAPITAL AND CYBER-SURVEILLANCE

As indicators of professional esteem, citations are highly valued in today's academic marketplace. The shift from text to individual as the unit of analysis creates the conditions necessary for the establishment of a symbolic capital market (compare Figures 4 and 5). This is a non-trivial sign difference, but easily misunderstood. Sosteric [28] notes that citation indexes can be used to make the work of scholars visible to administrators of the scientific enterprise. For rankings-conscious decision makers and funding agencies, citation analysis offers the enticing prospect of being able to monitor the performance of different research groups and highlight centres of excellence [37].

While some may welcome the transparency-inducing effects of citation analysis, others prefer to see it as evidence of an emerging culture of cybernetic control within academia. Sosteric [28, p. 5] construes citation analysis as a form of 'Orwellian surveillance net', which can be used to generate performance data on individual faculty members virtually on demand. The Jeremiahs are already claiming that the age of electronic panopticism has dawned in academe [34, p. 475]:

> We have drawn on Foucault … because we were interested in the parallels between Foucault's analysis of the development of institutions such as the penal system and medicine as new technologies of observation and control, and the work of citation analysis (CA) itself, which provides a new way of making scientific practice visible and recordable, and new possibilities for producing hierarchies of difference and categories of normal/abnormal scientific behavior.

However, this statement misses the point that such developments are an integral feature of advanced societies – and not necessarily detrimental to individual welfare [38, p. 69].

The meanings of references have little to do with the significance accorded to citations in the context of programmatic assessments. Evaluative bibliometrics ignores the grounded or situated nature of references, treating them instead as decontextualised citations; as indicators of a scholar's worth, merit or esteem, along with other objectified signs (e.g. publication counts, grant awards, scientific honours). The referent of the bibliographic reference is a specific work; the referent of a citation the absent text which it denotes (and all the other texts which point

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to it). In the case of large-scale citation counts the referents are the cited authors (rather than their published works). The need to disentangle these three sign systems (see Figures 2, 4 and 5) can be understood by looking at the UK higher education system where the prospect of institutionalised citation analysis is arguably stronger than in almost any other country. It is worth considering how the British government uses performance indicators (summable signs of scholarship) to foster selectivity. Antipathy toward evaluative bibliometrics has a long history in the country – Collini's [39] stinging attack on the prospective marriage of bureaucracy and bibliometrics in higher education is a good illustration of the distrust still felt by many. But, equally, it is not hard to understand the potential appeal of a putatively objective performance assessment method, such as citation analysis, within a centralised system wedded to notions of public accountability [e.g. 40].

Since the demise of the University Grants Council (UGC), the management of higher education has been placed under the aegis of the various Higher Education Funding Councils, one for each constituent part of the UK. *Dirigisme* has become the order of the day, routinely manifested in rolling research assessment exercises (RAEs) and teaching quality audits, the ground rules for which are notoriously fungible. In a matter of a decade or two, the balance of power in British higher education has probably been altered irrevocably, a point reflected in the title of Halsey's [41] expansive survey of recent trends, *Decline of donnish dominion*. With funding tied to national research rankings, competition between universities has reached unprecedented levels [42, p. 18]:

> Britain may have been the birth-place of soccer, but few would have predicted the extent to which the tactics of soccer managers have taken over the world of higher education. Last month the government announced the results of its research assessment exercise: a league table of departments and institutions resulting from the world's most comprehensive peer-review process … This year's results revealed how soccer-style transfers of researchers and other tactics aimed at improving a department's rating are now part of British academic life ….

Such developments have challenged long established cultural practices within the UK academic system.

SIGN AS SYNECDOCHE

The soccer analogy can be extended, with publications and citations being the equivalent of goals scored, on the basis of which bonuses are paid out to high-performing stars or teams. Quality within the context of the RAE is calibrated on an ordinal scale of one to five. The poles translate into 'national excellence in none or very few areas of activity' and 'international excellence in some areas of activity and national excellence in the remainder', respectively. Expert review panels determine departmental ratings for different subject areas, using both quantitative and qualitative indicators. These include peer assessment, number of research students and per capita performance indicators such as authored books, refereed articles and research income [43]. Currently, citation counts are not a component of the RAE model, though studies by Oppenheim [44, 45] make a superficially

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plausible case for using them as proxies for other, more costly and labour-intensive performance measures.

In his more recent study, Oppenheim assessed the correlation between the scores achieved in the 1992 RAE by all departments of genetics, anatomy and archaeology and the number of citations received by their respective faculties for the same period, based upon the ISI's citation databases. In each case, he found statistically highly significant correlations between the RAE rank and the ranks based on both total and average faculty citation scores, leading him to conclude [45, p. 477] that 'citation counting provides a robust and reliable indicator of the research performance of UK academic departments in a variety of disciplines'. Such a prospect takes us well beyond the semiotics of referencing to the commodification and ultimate legitimation of symbols of esteem.

In the admittedly unlikely event of the HEFC choosing to use citation counts as the sole or ultimate arbiter of departmental performance in some future research assessment exercise, we would by then have reached the point of sign as synecdoche. In such a scenario, an inevitable concern would have to do with the extent to which the multidimensionality of scholarly inquiry and productivity could be captured with reasonable fidelity through citation counts. More specifically, if an individual's, department's or university's ability to amass symbolic capital of this kind were to become the critical determinant of future research funding and career advancement, then it would not be difficult to imagine distortions creeping into the system, as players devised recruitment, publication, collaboration and citation harvesting stratagems to accelerate and maximise the accrual of symbolic capital.

The transvaluation of these stockpiles of manipulated and manipulable capital into objectified ratings and rankings would, in turn, create a most convenient index for policy makers to justify selective programmatic and institutional investment, what Sosteric [28, p. 17] implies by the phrase 'the *sensing* methodology (or device) of a cybernetic system'. The academy would finally have, in the words of Foucault [46, p. 208] commenting on the new physics of power represented by panopticism, 'mechanisms that analyse distributions, gaps, series, combinations, and which use instruments that render visible, record, differentiate and compare'.

CONCLUSIONS

What semiotics offers the bibliometric research community is a supra-disciplinary suite of insights and exegetical tools (such as the sign triads in Figures 1–5) to explore better the indexical significance of bibliographic references and citations, contextualised and decontextualised, within the scholarly communication system, so well described by Meadows [47]. Commercial (and other [48]) citation indexes have liberated references from their textual hosts, in the process creating a marketplace for a new species of sign – the citation. An understanding of semiotic principles may be one way of helping the bibliometrics/scientometrics research community develop greater sensitivity to the variable symbolic significance of the signs they routinely manipulate and treat as quasi-objective indicators of quality, impact and esteem. Semiotics cannot provide a unifying theory for understanding the intentional and extensional significance of citation, but it does offer a frame-

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work within which to examine specific phenomena and reproducible practices and to assess the strengths and limitations of the competing theoretical models.

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