

A (Cybernetic) Musing: Language and Science in the Language of Science

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Introduction: What We Do and What We Say We Do

I think I would want to argue that a central issue in second order cybernetics (or the cybernetics of cybernetics, as it was also initially known) is the relationship between how we communicate and what we intend to communicate (the Medium and the Message, as McLuhan (1967) punningly put it). Thus, for instance, the “nonsense” perpetuated in the scientific convention that there is a world we can know without our being party to that knowing, that there are experiments without experimenters and observations without observers, is certainly re-inforced by the conventions of scientific reportage. It might even be perpetuated, enforced or created by these conventions.

It has always seemed to me that this form of reporting was inherently dishonest in its pretence to being both impersonal and objective, and I have, on occasion used this to justify the fact that this column is personal and that the first person (my first person) often appears in it. To pretend that what is written is written without a writer seems to me to profoundly and intentionally misrepresent what is going on, at least as I understand it. It is not that the I needs to be at the forefront, always pushing for attention. Rather, it is that the I needs not to be excluded, for to exclude it is to create an epistemology that we cannot sustain. Without the I there would be nothing to report and no one to report it.

But how accurate is this image of scientific reportage? What do we actually write (as opposed to state and believe that we write)? Are these conventions actually shibboleths?

During the last year, while I was at the Swire School of Design at Hong Kong Polytechnic University, I came across some very exciting research that has been carried out in this area. The work was reported by Dr Sima Sengupta and Ms Gail Forey, lecturers in the Department of English, in a series of workshops I attended as part of the University’s Effective English Communication for Teaching and Research (EECTR) programme. It became apparent that what they were reporting was that:

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- Scientists no longer exclude themselves, as active participants, from their accounts of their scientific undertakings.
- Scientists present their work in language that does not report, but persuades and cajoles the reader into agreement. The scientist is careful not to offend and says what (s)he wants to say in a manner designed to invite the support of the reader. Their concern is to join a coalition. The operation is that of conversation.
- Scientific research articles now reflect our involvement in constructing our world view.³

The findings they were regaling indicate that, no matter what the official assertions within the fields are, their exponents implicitly accept and act within the framework of second order cybernetics, rather than traditional science.

With the editor's agreement the three of us have worked together to present, in this month's column, an overview of this research, presented within a referential framework of second order cybernetics, and to provide enough literature references to enable the interested reader to further pursue these understandings. Each worked separately at first, and then together in assembling the totality: which is not to say that each of us agrees wholeheartedly with every position taken here. But that is neither necessary, nor necessarily desirable: the process and the outcome are dialogical (or do I mean trilogical?).

Inevitably what we present is somewhat simplified. As we "indicate" (see later), we have left out much we would have liked to include—through a process of pruning that, at times, approaches attrition! But I believe it is still worth presenting what we have left. In fact, I find it incredibly exciting. It is a firm indication that, even if we have lost cybernetics (as Heinz von Foerster tells us it has become diffused⁴), its influence is truly all-pervasive in science.

The Claims Scientists Make: Objectivity vs. Collective Agreement

The conventional view, as told us by experts in research is that the scientific tradition can be characterised as being based on the belief that there is an independent social reality which can be described as it is, and that truth is defined as the correspondence between our words as researchers and that independently existing reality. It is held in this tradition that facts are presented factually. The interpretative tradition, on the other hand, postulates that social reality is constructed by individuals and "truth" is ultimately a matter of socially and historically conditioned agreement (see for example, Howe, 1988; Guba, 1990).

Yet is this concept of "reality" as being (exclusively) either "independently existing" or "socially constructed" a false dichotomy created and supported by myths about scientific objectivity? Hillocks (1992: 64) points to this, when he

[3] Strangely, while writing this paper, we found ourselves slipping into the impersonal and third person form in which the world is presented as occurring regardless of us, thus completely negating central points we were hoping to make. In Linguistics, ironically and in spite of the work reported here, it is only the most senior academics who can write in the first person. We have worked to bring us back into the story!

[4] Personal communication

says, “It is possible that our divergent assumptions about objective reality simply represent different metaphors about our relationship to reality.”

Authors do, indeed, use language to counteract this duality and avoid the pressure of choosing between the two extreme positions — and language helps us to take advantage of the (many) possible positions between the two extremes. We argue that the popular belief that scientists build their knowledge-base by always reporting the “**independently existing**” truth in an impersonal, objective and data-driven fashion is not an accurate representation of what actually happens in the scientific community. We support these claims with findings from a number of linguistic analyses. These analyses are ultimately a linguist’s representation of scientific discourse and, thus, are not presented here as “truth” but as possible ways of re-thinking and questioning our assumptions about knowledge-building in science.

A common perception today is of research as a quest for collective agreement rather than a search for truth. This collective agreement is between the members’ distinct disciplinary communities, called discourse communities by linguists⁵. An academic discourse community consists of a threshold level of members with a suitable degree of relevant experience and expertise to take part in the intercommunication between members, through participatory mechanisms (such as journals, newsletters, conferences and associations). Such a community has a common set of public goals, and specialised vocabulary and genre conventions⁶. The conventions of the community genre are reflected in the way members expect other members to express their claims to knowledge. A significant way in which academic discourse communities maintain solidarity is through scholarly exchange and feedback in conferences and publications, which play a vital role in profession building (Bazerman and Paradis, 1991).

The Claims Scientists Make to Further Scientific Knowledge

Research communication, therefore, is central to academic cultures as they promote disciplinary knowledge and establish personal reputation. By trying to publish in journals, academics seek endorsement of claims (Hyland, 1997). In this light, the research article is seen to be an ideological instrument of a discourse community where claims reflect forms of culturally determined knowledge. Knowledge in research articles is socially constructed and accredited. The study of language use indicates that a research article is NOT a body of “objective truth” but rather a way of persuading and convincing the community that the claims we make are reasonable and acceptable. From this position we may argue that there are two kinds of claims scientists (and, in the context of this paper, academics) make:

- Categorical claims referring to explicit knowledge shared by the community
- Cautious claims that attempt cumulative extension of knowledge

[5] Cf the familiar term “universe of discourse” borrowed by many cyberneticians from philosophy.

[6] See Swales, 1990 for a fuller description of discourse communities.

Because the process of knowledge construction involves collective agreement between members of a community — with its set of acceptable knowledge, methods, and criteria against which to evaluate and accept claims — scientists make cautious claims when they try to extend knowledge.

What do we mean by the term “claim”? Any opinion expressed is a claim, even though this opinion may be couched in empiricist, objective language. So, when a scientist presents the results of some experimental research, what they write expresses their own opinion of what we might call the “facticity” of the findings. This opinion, in their own minds, might, for instance, be that “*the findings are astounding*”— but scientists rarely assert such a claim because they want their opinions to be validated by their discourse community: and in order to convince they may need to be cautious! Thus they carefully craft their claims — buttressing their claims with citations. Often the language of the claims and citations are more than straightforward reference to their own findings or to the work of their peers.

The Claims Scientists Make and the Language They Use

Here a few words on the language we use for knowledge building and situating ourselves within the discourse community are in order. There are linguistic conventions that different disciplines follow — but these conventions change and are refined as the rhetorical situation changes. For example, as knowledge increases and audience requirements change, the length, language, referencing and argumentation in research articles change (Bazerman, 1989). At any given time, however, there are definite ways of stating a claim. These are (often unwritten) rules, applied almost automatically, geared towards making the research article sound like a simple description of what really happened. Yet the research article is often cunningly engineered by rhetorical machining that attempts to give an impression of objective simplicity. But if we go beyond the frigid surface of the research article discourse and look at the language, we see in this empiricist repertoire the constant presence of the writer.⁷ Thus, Stubbs (1986) argues that all sentences encode a point of view and that academic texts, including those created by scientists, inevitably indicate the author’s presence. In simple terms, therefore, given the fact that scientists are extending the knowledge base of science through their scholarly writing, they have to persuade their colleagues to believe them. Gaining audience acceptance of an argument depends on presenting claims that the disciplinary community recognises as reasonable and acceptable. This is where language comes in because language is reflective in that it is not only used for saying things but also reflects the status of what is said.

Ken Hyland (1996, 1997), at the City University of Hong Kong, has studied research articles from a number of disciplines, both sciences and humanities, and found that reasonable claims contribute to the “vocabularies of justification” used

[7] Which is why this research is so cybernetic! One of von Foerster’s aphorisms is that second order cybernetics is the cybernetics of observing (as opposed to observed) systems, while Maturana has iterated that (in various forms) everything done is done by a doer.

to publicly evaluate and justify scientists' professional actions. In essence, reasonable claims seek to search for consensus by:

- (1) responding to an existing and finite set of exigencies recognised by the community;
- (2) maintaining or expanding the community's understanding of natural phenomena;
- (3) representing empirical adequacy and accuracy in terms of prescribed methods;
- (4) corresponding to existing assumptions, theories and bodies of knowledge believed to accurately describe nature;
- (5) adopting the most certain and general position readers are likely to accept;
- (6) demonstrating a scientific ethos to the discourse community which involves:
 - (i) recognising previous work and acknowledging priority (ie, knowledge extension),
 - (ii) concealing a rhetorical identity behind a (pseudo) pose of objectivity, and
 - (iii) presenting a modest and collegial persona, demonstrating deference to, and willingness to negotiate with, one's peers.⁸

As knowledge in a discipline is generated, maintained and extended by the community, we search for consensus by expressing tentativeness. In this expression of tentativeness hedging plays a major role.

Hedging a Claim

According to Hyland, a hedge is any linguistic means used to indicate either a lack of complete commitment to the truth of a proposition or a desire not to express that commitment categorically. Hedges can be considered as interactive elements in texts which serve as a bridge between the propositional information in a text and the writer's factual interpretation.⁹

There are many reasons for hedging in science. Firstly, hedges signal the writer's anticipation of opposition to the claims and, thus, the writer's attempt to lower the risk of opposition. So a writer may wish to avoid a categorical statement, building in, instead, a degree of flexibility (tentativeness) in how a claim is expressed. However, this does not necessarily mean that the writer is deliberately being vague because there is any lack of certainty. Indeed Salager-Meyer argues that hedges are ways of being more precise in reporting results: hedges may well be used to negotiate an accurate representation of the writer's understanding, indicating that the writer feels a stronger claim may be unjustifiable in, and even uncharacteristic of, a science which in today's world is less deterministic and more sceptical than it once was. Myers (1989) adds another dimension to the use of hedges. He feels that hedges are politeness strategies which can be both positive (presenting claims pending acceptance) or negative (denying claims presented by other researchers). So hedges can both support the writer's position and build the inter-personal relationship between the writer and reader. And, lastly, hedges are now part of the conventions that scientific

[8] Quoted from Hyland, 1997.

[9] Cited in Salager-Meyer, (1997).

discourse communities follow. (Of course, these are the possibilities that linguists in their research have constructed—they are neither exhaustive nor meant to constitute an objective.)

One thing, however, becomes clear. When scientists say that their results “seem to suggest”—and linguists have found many instances of such language use—they hedge. Discourse analysts claim that such hedges are used to portray a reasonable, collaborative, socially-conscious image. There is a range of epistemic devices used to modify claims—claims pertaining to the writer’s own work and the work of the others the writer cites. These are principally:

- lexical verbs such as *indicate, suggest, appear and propose*; (see next section)
- adverbials (*quite, almost, usually*);
- disjuncts, that convey an attitude to the truth of a statement (*probably, generally, evidently*);
- epistemic modal verbs (mainly *would, may and could*);
- epistemic adjectives (*e.g. likely, possible and most*);
- modal nouns, such as *possibility, estimate, assumption and tendency* (not common)
- nouns or nominal modal phrases such as *assumption, suggestion* etc.
- introductory phrases such as *to our knowledge, it is our view*.

The reader may wish to know how commonly such hedging devices appear in scientific discourse. Godsen (1990) has found, for example, that modals appear to be the typical means of marking epistemic comments in research papers. Butler (1990) states that he found that modals used to denote uncertainty account for approximately one word in every hundred in the research articles he studied. However, the amount of hedging differs according to the communicative purpose. Thus, review articles are more heavily hedged compared with research reports. Salager-Meyer (1997) believes that the stronger the claim to universality the more hedged the discourse. So when the communicative purpose is to persuade, argue or appeal (such as the review paper, or the introduction and discussion section of a research article) hedges are common. On the other hand when the purpose is to report specific details such as case report or the methods section of a research article, the incidence of hedges is infrequent.¹⁰

A writer’s wish to “sound reasonable” helps promote her/his work. As writers we have an image of the reader. By hedging, writers (scientists and others alike) recognise the critical role played by readers and make claims that are both “objectively legitimate” yet “sensitive to audience expectation”. The community we belong to (or aspire to belong to) and the collective knowledge of that community both play a major role in our attempt to “sound reasonable”. This is where the lexical choices we make in alluding to the work of others fits in. In the rest of this column, therefore, we focus on lexical choices and examine the big impact that small choices such as one word have on the way we (scientists) wish to sound to our peers in our discourse communities.

[10] See Salager-Meyer, 1997.

Buttressing a Claim: Small Choices with a Big Impact

Further recent research in applied linguistics shows that the (scientific) writer, in attempting to “sound reasonable”, also actively manipulates both tense and aspect tense. This manipulation, whether overt or covert, demonstrates the writer’s attitude to other work in the field (Salager-Meyer, 1992, Hyland, 1997, Hunston, 1993a). Latour (1987) reminds us that it is necessary to refer to previous research in order to be taken seriously. Thus,

The presence or the absence of references, quotations and footnotes is so much a sign that a document is serious or not that you can transform a fact into fiction or a fiction into fact just by adding or subtracting references.

In trying to sound reasonable and persuade readers, the small choices we make (whether consciously or subconsciously) about each word we select to introduce referencing devices such as quotations and footnotes, impacts the image we are trying to create, thus influencing our acceptance within the academic discourse community.

For the purposes of this column we concentrate on only one aspect of citation (which is, however, indicative): verb choice.¹¹ In this section we take a closer look at recent research which demonstrates the power of such lexical items.

In their study of 100 articles from a range of disciplines, Thompson and Yiyun (1991) found that there were over 400 different verbs used to cite the work of others, for which they adopted the term “reporting verbs”. Do we, the writers, realise the power embedded in these verbs? It might be suggested that those gifted with the power of persuasive writing would be able to weigh automatically, for example, the benefit of using the verb “indicate” against using the verb “state”. (It is from this assumption that Sinclair, (1988) and Hunston (1995) both argue the verbs we choose to hedge our claims are embedded with particular evaluative connotations.)

So when establishing our credentials as authors and scientists we socially construct research articles, in part, by criticising others, and/or supporting and endorsing previous work — thus eventually creating our own research space within the discourse community. Swales (1990) states that for “novice” academic writers and (especially) those writing in a second language, embedded meanings within the semantics of lexical items are often unclear. This will be immediately apparent to anyone who has experience of editing, where, for instance, one has frequently to amend a paper purely because the author used a verb such as “indicate” incorrectly. The author, for whom English may not be her/his first language, may use “indicate” in an attempt to demonstrate her/his agreement with and support for previous research. However, Hunston (1994) (amongst others)

[11] Research has also been carried out on other aspects of evaluation in research articles—such as the use of adjectives, conjunctives, and tense.

shows that in its actual usage “indicate” is a weak reporting verb, normally used to refute or to lower our belief in the work being referred to: it is merely indicative!

Hunston (1993b) points out when we use verbs such as (the seemingly synonymous) “suggest”, “claim”, “state”, or “point out” to introduce previous work in our field one choice of each particular word represents a different level of agreement. By exercising our choice from such a list we demonstrate our degree of agreement or disagreement with the cited research or subject. In addition, if we chose to use an adverbial such as “extremely” or “almost” this further impacts the credibility we are trying to establish. The way we chose to make categorical claims vis-à-vis cautious claims is signalled by those small black and white symbols (words) through which we inscribe our views. Hunston shows this by

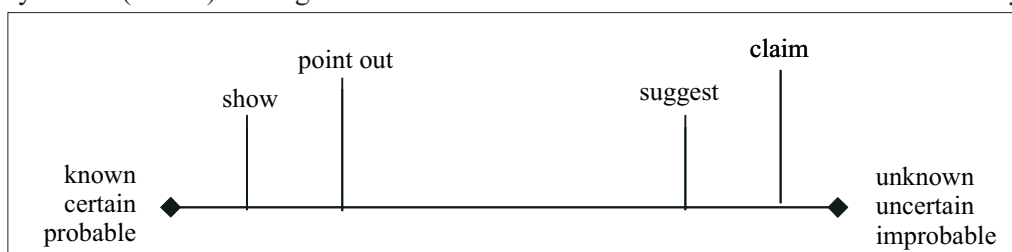


Figure 1. Reporting Verbs Continuum (Adapted from Hunston, 1993b)

placing such reporting verbs on a continuum from certain/known/probable to uncertain/unknown/unlikely, as shown in Figure 1 below:

In her work Hunston thus illustrates that scientists do not only represent their ideas by using those verbs from the more certain end of the continuum, but a much wider range of verbs from various positions on this continuum. This range varies, as has been said, from known to unknown, certain to uncertain and probable to unlikely.

The research of Hunston (1993a,b, 1994) in this area, and of others such as, Hyland, (1997), Gledhill (1995), Sinclair (1998), Swales (1990), is based on linguistic analyses into a corpus of authentic academic texts which has become available to investigators in the form of electronic texts. We regret there is not room in this column to introduce their extremely interesting detailed descriptions of how academics manipulate lexical choice.

How Do We Know This?

Much of this linguistic work has become possible because of the rapid development of computers, especially during the last ten or so years. Since electronic texts are now the publishing norm, there is an amazing amount of data available at the touch of our fingers which can form a corpus (a large body of material for examination). Such a corpus can be scientifically tested for (for instance) use, frequency and groupings of words. The ability to manipulate computer readable data of the written and the spoken word is now bringing into question many of the implicit ‘rules’ and definitions of English which were once

accepted as truth (for example see Collins Cobuild's book on "Grammar Patterns 1: Verbs"). Accurate research into how language is used in the sciences confirms that hedging and tentative language not only exists, but is prevalent in this field, that was once believed to be observer free (see references to web sites at the end of this column).

Corpus allows the linguist (or anyone with access—you don't have to be an expert) to experiment, search, test, and investigate how language is actually used. Sinclair, the founder of corpus linguistics, describes the growth in corpus:

Thirty years ago when this research started it was considered impossible to process texts of several million words in length. Twenty years ago it was considered marginally possible but lunatic. Ten years ago it was considered quite possible but still lunatic. Today it is very popular (Sinclair, 1991:1)

Millions of words both spoken and written are now in computer readable form and there are a number of commercial and shareware corpora available (See Svartvik, 1996, for a description of corpus availability). The number of computer programs such as Wordsmith (Scott 1997), which can be used to search and analyse texts are also expanding in number. Access to corpora of language and analytic programs allow the user to study real language in detail. It is this kind of information technology which has lead many lexicographers and linguistics to reassess their view of language. It is this technology which allows users to uncover how language is used in context. Naturally the only way to test the power is to speak to the readers of texts.

It is this kind of information technology which has lead many lexicographers linguists and applied linguists working in the field of science to reassess their view of language. This technology allows users to uncover how language is used, in context. However, the best method of testing the power and the choice of words and phrases selected to construe meaning is to include the interpretations of the real readers of text into any analyses.

There remains, of course, the eternal question as to how the method of analysis used (the tools) influence and form the results. To attempt an answer to this question lies outside our aims in this paper. But what remains unquestionably the case is that the use of corpus linguistics has allowed many questions to be raised, concerning both how language is selected and which language is selected to represent what we used to think of as truths about knowledge.

A Second Order Reading perhaps?

It might, therefore, both entertain and inform the reader to (re-)consider this column in the light of its content (a truly second order activity). This column, like all other columns of this nature, may be seen as a selection of results intended to support a claim. How does this column do what it describes? The authors have been acutely conscious of this question throughout the drafting of the column.

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Check out these Web sites:

- <http://www.engl.polyu.edu.hk/EECTR> [EECTR's Homepage]
- <http://www.liv.ac.uk/~ms2928/mconcord.htm> [soon to be available concordance package]
- <http://firth.natcorp.ox.ac.uk/BNC/online.htm> [you can do your own word searches using the British National Corpus (BNC)]