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Personality and impersonality in biotechnology discourse[1]

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1. Introduction

In recent years, natural scientists have had to face mounting pressure from two sides. For one thing, large parts of traditional life science disciplines such as biology, mycology, botany, etc, have changed into what has come to be known as biotechnology. Secondly, as demonstrated by Bergenkotter and Huckin (1995: p. 42) scientists have been increasingly burdened with high information loads, pressures to promote their research due to cut-edge competition among researchers and pressures to obtain external funding. As a consequence, it has become of paramount importance for researchers to publish articles promoting their discoveries, inventions or claims and at the same time to change their reading practices to accommodate a need for selecting newsworthy information without wasting time. The changes in reading processes, combined with the above-mentioned technologization of the life sciences, constitutes a change in the social practices reflected in scientific discourse to the effect that genre conventions used in the traditional research article are no longer strictly followed. (For detailed account on these developments, see Bazerman 1988; see also Gross, Harmon and Reidy 2002).

If we consider the example of biology, much of the fieldwork that biologists used to do has nowadays moved into the laboratory to be taken care of by biotechnologists. As a result, what used to be referred to by biologists as a field account has been replaced by something that we may refer to as a laboratory

[1] I am grateful to Professor Greg Myers and Professor Torben Vestergaard for insightful comments on an earlier version of this article. I would also like to express my gratitude to an anonymous reviewer, who offered some very helpful comments in the final revision process.

account – a kind of narrative that seems to be an obligatory move in scientific articles structured in accordance with the IMRD model (introduction, methods, results and discussion). (For a study of laboratory accounts, see also Lassen (2006)). Moreover, research focusing on field accounts from geology (Dressen, 2002; Dressen and Swales 2000; Swales 2004) has shown that the author is usually 'silenced' in this type of discourse, and Dressen's research corroborates findings by other researchers who have studied the role of authorial presence and absence in biology and molecular science research articles (see e.g. Myers, 1990, p. 80; see also Knorr-Cetina, 1981, 1999; Bazerman 1988; Gross, Harmon and Reidy 2002).

1.1. Aims

The aims of this paper are threefold. First, I wish to show a number of ways in which researcher-authors are silent, objective and implicit, but still present in the Materials and Methods section of two scientific research articles. Secondly, by comparing the written texts to an oral discussion of one of the texts analysed, I am going to demonstrate that the researcher-authors are considerably more salient and personal in the oral text, where epistemic modality is frequently used while the written texts are characterized by a high degree of affinity with propositions, which are presented as scientific fact. Thirdly, on the basis of my analysis I argue that the Materials and Methods section is so condensed and implicit that even researchers from within the field may have comprehension difficulties, unless they belong to the same community of practice and are part of the context in which the research article was written. The implications are that it may be difficult or even impossible to replicate research results, which used to be the litmus test of scientific method. This observation adds new perspectives on the significance of impersonality/ personality and consequently on the construal of scientific knowledge.

1.2. Historical background

The changes described in the introduction invariably reflect changes happening in scientific communities over time. In a study comparing scientific research written in the 17th century with 20th century articles, Gross et al found there to be marked variation. The 17th century style was characterized by elements from story telling. Facts were recounted, using verbs in the active voice, first-person narrative, minimal abstraction, few instances of specialized terminology (except for Latin names of plants), and few quantitative expressions or theoretical explanations (ibid: p. 29). Fact rather than argument was given priority (ibid: p. 19). The 20th century research article, on the other hand, hardly uses any of these features. Theory is given prominence over data, but there is a close interplay between the two. Visuals are used to support arguments, hedging is frequently used to signal objectivity, personal pronouns are rare, passive voice verbs relate to things and not to people, and there is a shift in syntax from clause complexity to group complexity.

Gross, Harmon and Reidy's findings are in line with Bazerman's (1988) analyses of articles from The Philosophic Transactions of the Royal Society of London (Transactions) published between 1665 and 1800 and experimental articles from Physics published in Physical Review between 1893 and 1980. Bazerman found a gradual development towards increasingly argumentative style and hypothesis-testing (ibid. pp. 66-68), which occasioned a need for a more detailed Materials and Methods section to function as proof of experiments or to challenge other researchers as shown in Bazerman's analysis of Newton's Optics (ibid: p. 69; pp. 80-127). Thus the research article, including the Materials and Methods section, seems to have evolved and changed style in answer of social requirements such as establishing credibility or convincing readers of the plausibility of results (ibid. p. 141).

Gross, Harmon and Reidy (2002: p. ix) do not find the change of style to be a problem, but rather perceive of it as 'an accurate reflection of the world as science conceives it, an effective means of securing the claims of science, and an efficient medium for communicating the knowledge it creates'. However, they stress the point that the changes in style do not necessarily reflect an improvement but serve as indication that what 20th century researchers have to say is more complex than what 17th century researchers had to say. This may be seen as a result of a number of 'selection pressures' such as increased cognitive complexity, higher standards of proof, a greater volume of data, and a dramatic increase in the number of scientific articles (ibid: p. 29). In their view, the scientific research article has thus not evolved to become better or worse, but to cope with communicative needs. (ibid: p. 219). I would argue that although the scientific research article in its present form may accurately reflect the world 'as science conceives it', then analysis of my data seems to indicate that it may not be 'an efficient medium for communicating the knowledge it creates'. Among other things, the stylistic changes referred to above raise the question whether these changes of style would possibly constrain the possibility of verifying scientific results, which is also known as replication. It is generally accepted that the laboratory account, embedded in the Materials and Methods section, is intended to make replication possible. In other words, if a researcher wishes to go over the experiment again, s/he should be able to do so just by following the 'recipe' offered in the Materials and Methods section. I shall revert to the problem of replication in section 7.

2. Methods

To bring to the fore some of the differences between scientific writing and scientific discussion, - differences which testify to the difficulties of replication - I have analysed 1) the Materials and Methods section of a research article written by an American research group, 2) the Materials and Methods section of a research article written by a Danish research group, and 3) a tape-recorded discussion where the authors of the Danish research article discuss the American article mentioned under point 1. [2] The Danish research article (written in English) was published in 2001 without revision, while its American counterpart was published in 2003, following 3 weeks of revision and resubmission. To tease out similarities and differences between the two texts and taking inspiration from Dressen (2002), I

[2] I am indebted to a Danish biotechnology research team for access to invaluable data used in this study.

explore authorial traces in the Materials and Methods section of the two articles, which both describe and discuss the sequencing of Expressed Sequence Tags (ESTs) in potato tissue. My linguistic analyses are based on Systemic Functional Linguistics (Halliday 1994; Halliday in Matthiessen 2004; White 2001; Martin and White 2005). I then compare traces of authorial presence in the texts studied with a tape-recorded discussion of the American article, which took place in the Danish research group.

3. Data and situational context

The data used in this article is obtained from two sources, viz. a Department of Life Sciences (DLS)[3] at a Danish university where I had permission to attend and record presentations and discussions by a biotechnology research group. My other data source is an article published by an American-based Institute (ABI). DLS is home to three engineering programmes, including biochemistry, environmental engineering and biotechnology. The biotechnology section was established in 1999 with four research groups, one of which is a protein chemistry group. The group concentrates on protein and enzyme structure, function, evolution, stability and application. In addition global tissue analyses such as proteome and transcriptome analyses are carried out on a starch-rich potato variety.

ABI is an American non-profit research centre, which was founded in 1992. The Centre has a number of research departments including microbial genomics, parasite genomics, plant genomics and bioinformatics, and in addition it provides education and conferences to scientific and local communities. The centre is a complex web of research activities with many partners, who – among other things – have been active in recording Expressed Sequence Tags (ESTs) in potato, including stolon, tuber, leaves, shoots and roots and deposit information about these parts in libraries of a public database. DLS sees the efforts by ABI as complementary and as a possible platform for their proteomics, bioinformatics and starch biosynthesis work.

4. Theoretical foundation

4.1. The scientific paper as a genre

The generic structure of scientific articles has been studied by Swales (1990, 1994 and 2004; Swales and Feak 1997), who found the scientific article to have four parts: introduction, methods and materials, results and discussion. Swales's contribution consisted mainly in suggesting a model for analysing the introduction section, but he also briefly commented on the methods, discussion and results sections, and it would seem that most science research articles follow the pattern described by Swales. On the basis of Swales's work, it is possible to identify a section I have referred to in this paper as a laboratory account because it enumerates steps taken in the laboratory experiments and seems to be embedded in the Materials and Methods section.

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[3] Names of Institutions, Departments and researchers have been anonymized in this paper.

The scientific paper represents the interface between laboratory processes and the outside world. Its function is to produce and document a result and at the same time argue a point. It is based on rationality, and it reflects but at the same time ignores what goes on in the laboratory. As observed by Knorr-Cetina (ibid. p. 94) ‘the scientific paper hides more than it tells on its tame and civilised surface’. In other words, despite the generally accepted view that the scientific paper constitutes a report of laboratory work, it also leaves out much detail observable in practice; moreover, in the process of transforming laboratory practice into a written paper, the unordered scientific reasoning taking place in the laboratory is institutionalised into a strictly monitored flow of reason in the research paper (Knorr-Cetina, 1981, p. 95). (For observations of a similar nature, see also Latour and Woolgar 1979; Latour 1987). In a presentation of scientists’ different approaches to reasoning in the laboratory compared to their approaches to reasoning in the writing situation, Knorr-Cetina (1981) offers a splendid overview of and rationale behind the various moves of the scientific paper. Following the convention of the IMRD model she describes the introduction as a reduction of laboratory work to just one line of argument, entirely leaving out what she refers to as ‘personal interest structures’ exemplified in mandates such as the need to find results that could be patented, the need to find more economical methods of production, or the need to succeed in qualifying for a position. Therefore what appears in the laboratory as a response to a chance to become a successful research team by following a new path of research is represented in the introduction as a response to filling a research gap, such as e.g. finding a new protein recovery method (ibid. pp. 100-101).

By implication, the introduction recontextualises laboratory discourse and at the same time decontextualises it in that agents, personal interest structures and mandatory concerns are suppressed. Knorr-Cetina (ibid.) illustrates the decontextualizing process through examples from the Materials and Methods section, which she refers to as an ‘action description’ of laboratory operations, but which are totally devoid of the types of epistemic modality frequently used in the laboratory and of the problems accounted for in the laboratory protocols. Knorr-Cetina (ibid. p. 114) finds that the Materials and Methods section typically brims with names of instruments, materials and descriptions of procedures ordered in sequence, but has no dynamic structure. All verbs are in the past tense, and it reads more than anything like a formula or as Knorr-Cetina puts it ‘a check list of steps taken’ (ibid. p. 115). In short the Materials and Methods section does not reason, but rather creates a logical, but decontextualised context for the Introduction.

While the Materials and Methods section is characterised by ‘formulaic recitation of procedural steps’ (ibid. p. 121), the Results and Discussion sections focus on similarities, differences and evaluations, and importantly, the order in which they are presented in the scientific paper in no way reflects the order in which they may be observed in the laboratory where results and discussion tend to influence and intermingle with method. All of this leaves the general impression of the scientific paper as an exercise in recontextualisation and depersonalisation, to which the

Materials and Methods section contributes through its conventionalised and formulaic style.

However, as demonstrated by Knorr-Cetina (1981) the style is motivated by human reasoning and social interaction, and one might assume that this will leave certain traces in even the most depersonalised and decontextualised parts of the research article, a point I shall argue later. From what has been said above, it would seem that the moves found in the research article following the IMRD model tend to serve the purpose of providing contexts for each other, but that the research article as a whole tends to both recontextualise and decontextualise laboratory work.

4.2. Authorial traces

In an impressive study of textual silence and salience in field accounts from three areas of modern geology, Dressen (2002) explored authorial traces in a corpus of 103 recent research articles from 9 different journals published between 1996 and 1999. The three areas were geochemistry, petrology and structural geology. Comparing field accounts to what she called ‘sampling discourse’, Dressen found that unlike sampling discourse, the field account makes up a specific part-genre due to its functional viability and more elaborate nature (2002, pp. 131, 135). By contrast, sampling discourse was found to be limited to one sentence indicating that samples were collected (ibid. p. 124), - an observation that also seems to be valid for the research articles discussed in this paper. Dressen further made the observation that due to a shift during the 60s in geology work practices from field research to laboratory experimentation, ‘primary research concerns have been relocated from the field into the laboratory’ (ibid. p. 87), a change that is demonstrated in Dressen’s comparison of field accounts past and present.

Dressen’s findings are further corroborated in some of her studies of research articles written by geochemists, where field activities seem to centre around the collecting of samples for experimental purposes (ibid. p. 118), but where little or no information is offered about the field mission as such. Dressen’s findings are thus very much in line with Gross, Harmon and Reidy’s analyses of the scientific research articles from the 17th and the 20th centuries (2002) – results that are also supported by other studies of scientific research articles (see e.g. Swales 2004).

Inspired by Halliday (1993: p. 146), who recognises part-genres through the ‘clusters of features’ they represent, Dressen (2002, p. 168) bases her approach to identifying linguistic features on what she calls authorial traces, salience and silence, and in what follows I shall use the same approach on the Materials and Methods sections of the two research articles described above. The framework suggested by Dressen indicates a cline of traces moving from researcher salience to silence. An adapted version of Dressen’s model is shown in table 1:

Table 1: Traces of research activity in the laboratory (adapted from Dressen, 2002)

1. **Strong authorial implicature**
   a. Personal pronouns
   b. Agential statements of activity
   c. Evaluative adjectives and adverbs

2. **A disguised account of research activity**
   d. Nominal indications of activity
   e. Verbal indications of activity
   f. Measurements
   g. Location markers

While the researcher is relatively salient with strong authorial implicature in a), b) and c), this position is gradually backgrounded with only very vague evidence of the researcher's presence in the field or laboratory as we move towards g.

5. Analysis: Materials and Methods sections

In what follows I shall offer examples from the categories shown in table 1 found in the Materials and Methods sections of the two articles explored.

5.1. Strong authorial implicature: The passive voice

In the texts (shown in the Appendix) there are no examples of personal pronouns or self-reference in the Matrials and Methods sections, which rules out the most salient of author positions. However, in spite of its depersonalising nature, the passive voice then becomes the clearest authorial trace available in that it reflects human activity even when agency is elided as shown in the following sentence: *field grown potato tuber was harvested at the end of season*. The researchers who did the harvesting are only present by inference, but we have no difficulty in inferring that 'harvesting' involves human activity. In both articles the majority of verbs in the Materials and Methods section are past tense Material Processes in the passive voice, used for recounting research activity. The Journal's styleguide made no requirements on authors to use the passive voice, but authors were recommended to consult recent issues for style. Topics seem to determine which processes are used and in the Amrican article where libraries are a constant topic, 'to construct' is the most frequently used process, which is not surprising as it collocates with 'library'. Other frequent processes are *isolated, extracted, cloned, frozen, fractionated, grown, trimmed, prepared, discarded, added* and *stored*, all of which signal research activity. However, despite the high level of activity indicated in the Materials and Methods section, all grammatical subjects consist of nonconscious Participants that are Goals dressed up as Actors with all human Agents elided.

5.2. Strong authorial implicature: Evaluative adjectives and adverbs

An area in which authorial presence may be observed is in evaluative statements, often centred on adverbs and adjectives. There are remarkably few of these in the two articles, in fact only one example in the Danish article, shown in example 1:

Example 1:

> *Polymerase chain reaction (PCR) products* <u>*suitable for sequencing*</u> *were generated*

in which <u>*suitable for sequencing*</u> may be said to convey the researcher's Judgement of the products as *suitable* or *unsuitable* for sequencing. If assessed suitable, the products are sequenced, if not suitable, they are discarded. The American article has only 3 evaluative terms (<u>underlined</u>), viz. <u>*low-*</u>*quality*, <u>*low-*</u>*complexity* and <u>*high*</u> stringency. One of these is shown in its co-text in example 2:

Example 2:

> *Vector and low-quality bases were trimmed, using an in-house program.*

The fact that certain *bases* may be assessed to be of low quality by the researcher indicates that some kind of evaluation has been going on in the laboratory, resulting possibly in a selection of high-quality bases and a trimming of inferior bases. What is meant exactly by low quality in this context is not clear due to the vagueness of the term, and this might cause problems if the experiment were to be replicated, unless the values of low-quality, low-complexity and high stringency are pre-defined by the research community or by the biotechnology programme used.

5.3. Disguised research activity: Nominal indications

As we move down the continuum of authorial traces, we find other markers of disguised research activity such as process-derived nouns, which may be seen as hybrids of human Actors and verbal Processes. In other words, if the hybrid allows us to discern human activity dressed up as a depersonalised nominal structure, what we see is disguised research activity. There are various motivations for presenting information as Nominal rather than as Verbal groups. For one thing it offers the possibility of word economy; secondly, it makes it possible to pack information by adding premodifiers in front of the head-noun; thirdly, by deleting the agent the text becomes less precise and perhaps even ambiguous because it may at times be difficult to decide whether an agent-less verbal process was initiated by a human or a non-human Actor. In the two articles there were many examples of process-derived nouns as shown in table 2:

Table 2: Nominal indications of research activity: Process-derived nouns

The DLS-article		The ABI-article	
Nominal group	Function in clause	Nominal group	Function in clause
cDNA synthesis was carried out	Participant/Grammatical subject	….after *ligation* they were cloned	Circumstance (time)
CDNA was size fractionated *by gel filtration*	Circumstance (manner)	…after *challenging* incompatible leaves	Circumstance (time)
…followed by in vivo *excision*	Circumstance (time)	…allowing for *the segregation* of possible alternative splice forms	Circumstance (manner)
The PCR included *a final extension*	Attribute	…were used for cluster *analyses*	Circumstance (purpose)
The control of size was performed	Participant/ Grammatical subject	K means *clustering* with initial *calculation* was performed	Participant/ grammatical subject
Primers were removed *by enzymatic digestion*	Circumstance (manner)		
..followed *by inactivation*	Circumstance (time)		
Putative identification was carried out	Participant/ Grammatical subject		

It will appear from table 2 that the Materials and Methods section of both articles has examples of process-derived nouns, but without using nominal style extensively. In most of the examples the process-derived noun functions as Circumstance in a clause. This serves the purpose of packing the contents of what would otherwise have been a sub-ordinate clause into a nominal group, thus economising on space.

5.4. Disguised research activity: Verbal indications

This category includes, in addition to the passive voice and deleted agency, the type of process-derived adjectives that may function as pre-modifiers and post-modifiers in the nominal group. The use of pre-modifying adjectives does not vary much in the two articles studied, while postmodified reduced relative clauses are only used in the ABI-article as shown in table 3:

Table 3: Verbal indications of research activity: process-derived adjectives

The DLS-article	**The ABI-article**
Pre-modifying adjectives	**Pre-modifying adjectives**
Field-grown potato tuber	*Transposable* element sequences of Arabidopsis
The *excised, amplified* library	…*unmatched* overhangs
Defrosted bacterial glycerol	..using *in-vitro grown* tubers
A *searchable* flat database	…late-blight *pathogen-challenged* leaf tissue
An *unclassified* group	
Post-modifying reduced relative clauses	**Post-modifying reduced relative clauses**
No examples	..the protein *required* for a TC or singleton EST
	By using transcript abundance in each TC *inferred* from the EST frequency…
	…leaf tissue *collected* at 24 h post-challenge
	..stem cuttings *cultured* on a medium
	…*obtained* from greenhouse-grown plants
	…roots *grown* in vitro

In terms of disguising research activity, pre-modifying as well as post-modifying reduced relative clauses are a stylistic device used by writers for 1) elegance, 2) economy of language and 3) eliding the agent or Actor, depending on whether the reduced relative clause originates in a clause in the passive or the active voice. There are thus clear traces of the author in these structures.

5.5. Disguised research activity: Measurements

Human research activity and presence in the laboratory may moreover be indicated through numerous measurement markers as shown in examples 3, 4 and 5:

Example 3:

> *The average insert size was 1.5 kb (DLS-article)*

Example 4:

> *Glycerol was added to a final concentration of 15% (DLS-article)*

Example 5:

> *Sequences sharing greater than 94% identity over 40 or more contiguous bases with unmatched overhangs less than 39 bases in length were placed into clusters (ABI-article).*

In example 3 there is trace of a researcher who has calculated the average insert size of the information load added to a library consisting of cloned cells. Example 4 implicitly tells us that a researcher has measured the glycerol content added. If we placed the sentence in its proper context we would find that the adding of glycerol is part of an experiment involving infected plant cells. Similarly in example 5, we discern the researcher as someone who measures the identity of sequences in order to select bases for cluster analysis.

5.6. Disguised research activity: location markers

Research activity may further implicitly manifest itself through markers identifying the movements or locations of the researcher in the field or the laboratory. This may be illustrated through examples 6 and 7:

Example 6:

> *Field grown potato tuber was cut into pieces and frozen in liquid nitrogen <u>in the field</u> (DLS)*

Example 7:

> *Sequences sharing greater than 94% identity over 40 or more contiguous bases with unmatched overhangs less than 30 bases in length were <u>placed into clusters</u> (ABI).*

Example 6 indicates a geographical place (the field) where a specific activity (cutting potato tuber into pieces and freezing the pieces in liquid nitrogen) takes place. It thus indicates the presence of a human being in the particular location in which the sampling activity took place. Example 7 is more implicit in that there is no indication of a specific location in the laboratory, but instead, a directional movement is instigated by the researcher, who instructs the computer to do the *placing into clusters*. The movement is signalled through the preposition *into* combined with a Process indicating movement caused by a human actor (to place).

5.7. Collecting sampling material in the two articles

In addition to the authorial traces discussed above, the Materials and Methods sections further embed what Dressen 2002) has referred to as sampling discourse and none of the articles had a separate field account. The DLS-article opens the first sub-paragraph with sampling discourse as shown in example 8:

Example 8:

> *Field grown potato tuber (var. Kura) was harvested at the end of flowering, washed in 9.5% sodium dodecylsulfate, cut into pieces and frozen in liquid nitrogen in the field. RNA was extracted from 5 g as described by Scott et al. [12][….] cDNA was size fractionated by gel filtration and cloned unidirectionally into the λZAPII vector.*

It will appear that part of the sampling, indicated by a full stop, took place in the field while part of it was carried out in the laboratory. Whereas the sampling information is presented in the DLS-article as finite clauses in the passive voice with the potato and cDNA as Goals in subject position, the same type of information is constructed either as Circumstance or as reduced relative clauses (underlined) in the ABI-article as shown in example 9:

Example 9:

> *The healthy leaf library was constructed from leaflets and petioles obtained from greenhouse-grown (8-week-old) plants. The sprouting eye libraries were constructed from 2- to 15-mm germinating eyes from Kennebec tubers. The stolon library was constructed from developing axillary buds of potato nodal stem cuttings cultured on a medium that induces tuber formation (Bachem et al., 1996).*

The implications of these differences are that in example 8 the plant material being operated on (the potato tuber) is foregrounded as the object or focus of activity while this position is occupied by various types of libraries, using circumstances of manner (means) to construct the libraries. The plant materials are thus backgrounded in example 9. However, irrespective of the differences in their construction of sampling activities, both articles show clear traces of researcher activity in the laboratory and to a limited extent in the field, although it seems that field activities have been reduced to a minimum as suggested earlier. It should be noted, however, that in spite of the limited space given to the embedded field account and thus to personality, many hours of work have been put into growing, harvesting, cutting and freezing potatoes for subsequent laboratory work, although the majority of sampling time is spent in the laboratory, preparing the experiments.

6. Analysis of oral discussion of a scientific research article

To have an idea of how specialists construe meaning from a Materials and Methods section written by specialists from a different community of practice, I compared the written material with an oral discussion that took place in a Danish Life Sciences research group on 5 August 2003[4]. In what follows I present extracts from the recorded and transcribed discussion of three research group members, whom I shall refer to as Head of Project (HP), Associate Professor (A/Prof) and Assistant Professor (Assist/Prof). The discussion was held in English due to the presence of researchers from abroad and the transcription renders as accurately as possible what was said.

The discussants approached their task from a critical angle and may thus be characterized as resistant readers. The article was selected by the head of a project on potato research and was discussed in a Wednesday morning laboratory group meeting attended by Ph.D. students, master's students and staff members affiliated

[4] The discussants were native speakers of Danish using English as the language of communication in laboratory group meetings.

with the biotechnology group. The assistant professor had been assigned to present the article, which reported on research similar to research carried out by the Danish research group. Moreover, the article referred to research by the Danish group, which further motivated the choice. As we shall see, the discussion foregrounds a number of purposes that each contributes to our understanding of how the Danish research group negotiates different knowledge positions in a joint attempt at construing and coming to terms with the methods used by a foreign and competing research group to achieve the goal of *understanding potato physiology better* – a goal shared by the two communities of practice.

In the discussion, a great many rhetorical purposes may be identified through language resources used interpersonally as well as ideationally. The discussants look for errors to substantiate their critical attitude towards the contents of the article and in the process negotiate knowledge, legitimize scientific approaches, position themselves in an interchangeable hierarchy of learners and experts, and express concerns about risk resulting from what they find to be a lack of trustworthiness caused by inadequate research methodology. In what follows I shall offer examples illustrating some of these rhetorical purposes. In Text 1 HP, taking on the role as chair, initiates the discussion by setting up a teacher/ student relationship in which the hierarchical pattern is made clear from the outset.

Text 1:

HP: OK – today I suggest that we actually go through a recent paper from an American research group. [,,,,] And I think that it is important that we know what **they** think **they** can extract from **their** data and Assist/ Prof will go over it, and I must admit that really in this …. I am <u>rather disappointed</u> – yes – at how <u>little **they** got out of this mass of data</u> – but let's see – it seems that it's – eeh – a purely bioinformatics person who has been writing this and not a biologist.

Assist/ Prof: First of all I must say that I was also <u>disappointed</u> in it all because this seems like eh – <u>one man's work</u> – eh – well I think that I could have done eh ….

A/ Prof.: And **they** are <u>twenty writers</u>?

HP's skepticism is indicated through *the attribution* of epistemic modality to the research group that wrote the article, exemplified in *what <u>they think</u> they can extract from their data.* HP makes her Attitude clear in a statement of Affect: *rather disappointed*, and the object of her disappointment is quantified in how *little* they got out of this *mass of data*. The Assist/ Prof shares HP's disappointment, adding a new quantification, viz. *one man's work* – an observation that is supplemented by a third example of quantification uttered by A/Prof, who mentions that there were *twenty writers*, thus suggesting that in spite of the many writers, only little came out of it. In spite of their different positions in the hierarchy of academics, the three discussants thus set out from a common platform of being critical towards the article, which has a bonding effect indicated by the use of personal pronoun *they* about the American research group. Skepticism over research results continue throughout the discussion, which may be illustrated with examples shown in text 2.

Text 2:
HP: But they <u>don’t document</u> anything.
Assist. Prof.: No, no, no, <u>it’s really annoying</u> that ….
A/Prof.: So they might just have <u>screwed up their blast</u> and then <u>polluted</u> …..
Assist. Prof.: No, I don’t think so, but …. I mean …. Why do they mention comparisons to private data which <u>they cannot look at</u> ….
[…..]
HP: What is <u>annoying</u> me is that they list genes that they <u>just see</u> in one pattern. That’s <u>not significant</u> …. I mean if they had seen it 5 times or a certain number …. But one time
[…..]
HP: Ok, one thing that …. I’m surprised that <u>good scientists</u> like NN and NN <u>want their names in this kind of a paper</u>.
Assist/ Prof: Don’t you think it’s …. For me it’s <u>just a status paper</u>, but it <u>shouldn’t have</u> been in a prestigious journal – they <u>should have had</u> more biology.
[….]
Assist/ Prof: But I think it is also <u>stupid</u> that why didn’t they just include our library in the analyses so they could give a potato-wide analysis and <u>not just a</u> …. That <u>would have been more interesting</u> to include everything.
A/ Prof: I think, they, they feel they have a dataset – *the* dataset – and then this is driven by computer people who are <u>just analyzing</u> the dataset – and then that’s it – and that’s that – and I think ….. *we have a different approach in the sense that we realize that we need to integrate all the information we have.*
Assist/ Prof.: This is the paper I would have made from all the data that was available. The only thing I needed was a bit more information on the libraries and the cells.
A/ Prof: Then you can be happy that there is still room for your paper.
[……]

In text 2, attitude is expressed through the emotion of Affect such as *it’s really annoying*, *what is annoying is that…* and *I’m surprised that….* Moreover, negative Judgement is used to signal incapacity or lack of research integrity in examples like *they don’t document anything*, *they might just have screwed up their blast*, *they should have had more biology*, or *they mention comparisons to private data, which they cannot look at*. In the last of these examples negation is used to signal that ‘they’ omitted doing something they ought to have done, and negation is frequently used to express inadequacy such as in the statement: *they don’t document anything*. The adverb *just* plays a salient role in text 2 in the way it is being used to downplay the significance of the American research results, again stressing that very little has been achieved from massive data. Examples are: *it’s <u>just</u> a status paper* or *why didn’t they <u>just</u> include our library* or *computer people who are <u>just</u> analyzing the dataset*. Text 2 signals various types of bonding such as between biologists against computer people (who are just analyzing the dataset) and between the three discussants against the American research group. This is made clear in the A/Prof’s final comment: *then you can be happy that there is still room for your paper*, a statement that indirectly evaluates the research results of the article negatively and encourages Assist/ Prof to publish a research article in which he could include all necessary information. Bonding is also created by setting up a social role relationship of ‘we’ versus ‘them’ exemplified by the A/Prof’s comment: *we have a different approach in the sense that we realize that we need to integrate all the information we have*. In the context, saying that ‘our approach is different’ would imply that it is better.

Text 3 is an extract from the discussion where the legitimization of research methods is foregrounded and where at the same time the three discussants negotiate their knowledge capital to arrive at a shared platform of understanding:

Text 3:
HP: Annexin – is that a system incorporating proteins and membranes or what’s the function of annexin? You <u>ought to see</u> an annexin spotter on the codereading. [….] But here they also <u>just write something messy</u> and they’re <u>not very</u> …..
A/Prof.: *That’s why we should make a proper naming of stuff* …. We still have this problem, I mean …. We <u>don’t get information</u> from the names they put …. Except for us that have similar lists that we compare to, because there is no biological information.
Assist.Prof.: Not a lot.
HP: But DnaJ we agree is highly abundant.
A/Prof.: And there is also C2 – they see DnaJ and the DnaJ light, and of course, obviously, we don’t know how much alive it is.
Assist. Prof.: And then there is also catalase, but I suspect that this is present in all 9 libraries but most in the pathogenesis related libraries.
HP: So, after all, there is ….
Assist. Prof.: Yes, because if you look.. ehm…
HP: It should be very predominant in the incompatible libraries as one of the defence mechanisms that ….
Assist/Prof: I mean .. if you compare it to this one you find that catalase, which is this one, was one of the most abundant proteins in that library …. There were 19 of it…
A/Prof.: …which is our library or what?
Assist. Prof.: That’s their library
A/Prof.: OK
Assist. Prof.: That’s the incompatible EST library.
HP: This is the Assist/Prof’s analysis of their leaves compatible and incompatible library.

In text 3, HP continues evaluating the article negatively, stating: *But here they also just write something messy, and they are not very ....*, presupposing through the adverb ‘also’ that there are other examples of ‘messy writing’. A/Prof uses the opportunity to bring into the discussion the need for integrity in research methodology by suggesting: *That’s why we should make a proper naming of stuff*, at the same indicating that only scientists with similar lists would have a chance of interpreting the labels in the article because of their lack of informative value for those outside the discourse community. In the rest of text 3, the discussants try to make meaning of what they read in the research article, helping each other to interpret what they do not immediately understand. In this process, the three discussants navigate through the text by using interrogative clauses to tease out meaningful answers, however not always with success, as shown in the A/Prof's last comment: …..*which is our library or what*? And the Assist/Prof's clarifying response: *That's their library*, - a comment that is set straight by HP, who explains: *This is the Assist/Prof's analysis of their leaves compatible and incompatible library*, thus disclaiming responsibility for her utterance by attributing it to the Assist/Prof. The subject matter of the article, viz. sequencing of ESTs, was done not by the A/Prof, but by the Assist/Prof, who is then expected to be in a position to interpret the results found by the American research group. This indicates that although the HP is on top of the hierarchy, followed by the A/Prof and then by the Assist/Prof, there are certain areas where the Assist/Prof is 'in the know' while the other two are in a learning situation. However this social role relationship is reversed in other situations as indicated in text 4, where HP instigates a teacher/ student relationship, asking the Assist/Prof to explain a special method of clustering.

Text 4:
HP: Would you go over the K-means method?
Assist. Prof.: Well, the K-means is …. What you are looking at here is just the K-means or zero. So there is one cluster here. So what you can do is – you can say I already know – I suspect there will be this number of clusters. E.g. there are 6 libraries here so I will expect 6 different gene expression patterns to occur.

And in text 5 we see how the social role relationship shifts from HP being in a teaching position to being in a learning position, and A/Prof taking over the role of instructor.

Text 5:
HP: But I don't <u>know</u>, why are your counts lower than the last count here in table 2?
Assist/Prof.: Ehm, you <u>mean</u> compared to the previous one?
HP: Yeah
Assist/Prof: Certainly, I don't <u>understand</u>.
HP: Unique sequences or sequences?
A/Prof: OK, I can <u>explain</u> if I may.
Assist/Prof.: Yeah, sure.
A/Prof: You <u>see</u>, the unique sequences in table 2, ok the first one is just the sum of TCs and the number of singletons within a library. OK? So for example for stolon, that will be eh 3570 + 1676. OK – in the other two, now we <u>say</u> all these unique sequences we have for the other one, now we subtract for each library the sequences that are <u>seen</u> in another library. Then that 5246 comes down to 2,000 of these sequences which are not <u>seen</u> in any of the other libraries.
Assist. Prof.: You <u>mean</u> this is a … this is a transcriptome wide analysis and the other is just for each library?
A/Prof.: Yes, you can <u>put it</u> that way.
HP: So that <u>means</u> that actually they never count more than 13,000 different genes?
Assist. Prof.: and some which are uniquely present
HP: no that must be…
Assist. Prof. and A/Prof.: No, no because they then …..
A/Prof.: …. All the ones that are …. All housekeeping genes for example won't show

up in this sum … because they are <u>seen</u> in more than one library ….
Assist. Prof.: yeah, yeah….
A/Prof: and so .. eh … the total there is without any interest, really
HP: Yes, of course.

There is a high frequency of Sensing and Verbal processes in text 5, such as *know, mean, understand and see* (Sensing), and explain, say and to put it (Verbal), which indicates cognitive and verbal activity. This is to be expected in a text part in which something is being explained with the purpose of being understood. It is therefore of some interest to look at who explains to whom as this may show something about social role relationships, which play a salient role in interactions of the sort reported here and which invariably have a bearing on the outcome of the scientific research article, which may be seen as the end result of knowledge negotiated in discussions about science. At the beginning of the extract, HP asks a question: *But I don't know, why are your counts lower than the count here in table 2*? It is difficult to assess at this point whether HP's question should be seen as a genuine question asked in order to learn or it is a question to assess the Assist/Prof's knowledge. However, towards the end of the extract, HP indicates that she has understood the nature of things when she replies *Yes, of course*, and it would therefore seem that she takes on the role of learner in the brief text passage. This is a role she shares with the Assist/ Prof, who bluntly admits that he is unable to explain. This is seen from his utterance: *Certainly, I don't understand*, which signals an attitude of incapacity. But the A/Prof comes to their rescue with an explanation that both the HP and the Assist/Prof seem to be willing to accept, and they thus accept the roles of learners, while the A/Prof temporarily takes on the role of expert. Of further interest in Text 5 are the frequent interruptions and incomplete sentences, which tend to increase in frequency with the discussants' eagerness to get their message across.

An additional point to be made is that throughout the discussion, the A/Prof shows a great deal of concern about research integrity and trustworthiness, and he repeatedly points to the importance of using legitimate approaches. This may be seen from the following extract:

Text 6:
A/Prof.: I always have – like a worry gene …. Ok. If we are doing this kind of a new biology, the principle of this new biology is that we do stuff – we sort through the data in automatic <u>unbiased fashion</u> and then see what comes up. If we have to introduce steps, somehow where we have a manual interpretation to make sure things make sense, then we are <u>short circuiting the basic principle</u>, and that's where <u>my worry gene activates</u>, you can say. And so – ok – here is a dangerous area – or we might introduce potential areas that they dub from <u>the trustworthiness of the result</u> in the end.

In text 6, the A/Prof suggests that the research article discussed raises doubts about trustworthiness, due to inaccessible representation of research results and the consequent need to interfere with test results through manual interpretation rather than relying solely on automatic and unbiased generation of results. This way a new problem is created as a result of solving the old problem of bias caused by human observation and the lack of proper and accurate criteria for replication.

It will appear from the extracts that the three Danish researchers generally have difficulties understanding the approach described in the Materials and Methods section of the American research article. This may be due to a number of factors such as the very condensed style required by conventional practice, inadequate coding systems, important details perhaps having been omitted, or lack of properly labelled categories for proteins, etc. Some of these problems may occur because the discussants do not belong to the same community of practice as the American scientists. However, it should be noted that even researchers belonging to the same community of practice negotiate knowledge from different levels of understanding as has been demonstrated in the present analysis. For one thing, research communities of practice have members at all levels, ranging from Master's students to Ph.D-students, post-docs, assistant professors, associate professors and full professors, and it goes without saying that a hierarchical scale of qualifications, and hence positions, is reflected in a hierarchical scale of knowledge. But equally important is the fact that not every member of a community of practice possesses the same skills. A scientist who has specialized in mass-spectrometry may not be literate when it comes to reading RNA-sequences or gene sequences, but by convention scientists normally write joint research articles, thus combing different skills and knowledge negotiated in discussions like the one analysed in this article.

A striking feature is that compared to the Materials and Methods sections in the written research articles, the oral discussion has many evaluative Judgements such as *that's a problem, it's really annoying*, etc. In extract 5, which offers examples of negative Judgement of the Danish researchers' comprehension capacity (I don't understand) and in extract 3, which stresses the American group's lack of skill (we don't get information…), we see how criticism continues and foregrounds a comprehension problem with perhaps dire consequences for the construal of science.

7. Replication of results

As mentioned in the introduction, one of the purposes of the Materials and Methods section is assumed to be the replication of results. In a study undertaken by Mulkay and Gilbert (1991: 154-166), in which scientists were interviewed about approaches to replication, it was found that in spite of scientists' claim that 'exact experimental repetition is crucial to science', they rarely engage in reproducing results by other scientists, even if they still maintain that other scientists have confirmed their work through experimental variation (ibid: 160). In other words, what is crucial to the validation of science is that the same conclusions may be reached by using a different method. Therefore what Mulkay and Gilbert - quoting an interviewee - have referred to as 'mere replication' is rarely done. This is also confirmed in Knorr-Cetina (1981: 129) through a statement made by a scientist, who was interviewed about the difficulty in understanding the description of how an author has proceeded (cited in 1981: 129). As further corroborated by the data analysed in this article, it is also questionable whether the Materials and Methods section actually contains all the information necessary for confirming scientific research results:

> *There is a problem, of course, if one wants to replicate a result or repeat a method. As a rule, however, one does something else anyway. Hence, it is not so interesting to know exactly why and how certain things were done ….*

The quotation suggests that the possibility to replicate results may not be of crucial importance to some scientists who see it as their primary task to produce innovative and patentable results rather than to engage in time-consuming basic research. This point is also argued by Collins (1985), who discusses some of the complexities of doing replication. Collins suggests that results are often not replicated as a result of lack of a common understanding of what replication entails. Thus, difficulties in defining criteria relating to accuracy, personal bias and analytical approach present a serious obstacle to replication. However, these difficulties bring about what Collins (ibid: p. 148) has referred to as ‘changing orders’, which are brought about by scientists who are ‘prepared to risk new ways of doing things, which may again enable the flow of new ideas.

However, whether scientists try to reproduce results or they give priority to experimental variation as suggested above, they will invariably take an interest in how other scientists have reached their conclusions, and they rely on the Materials and Methods section for the necessary information. Therefore, it is not unimportant whether the Materials and Methods section of the scientific research article is comprehensible. In spite of the many complications and varying attitudes, it is however the commonly accepted rationale behind the Materials and Methods section that replication ought to be possible.

The paradox of replication expectations poised against the absence of replication efforts may in part further be explained by requirements by scientific journals. To give an example, the American Journal of Plant Physiology states in their instructions for authors that the Materials and Methods section ‘should reference all standard procedures but must be complete enough so that results can be verified by other laboratories’ (2005: p. 5), a requirement that is summarized by the Journal in the following statement: ‘To summarize, sufficient detail should be provided for the experiments to be reproduced’ (ibid.: p. 6). As my analyses have demonstrated, it is, however, uncertain to what extent the Materials and Methods section, by its very nature, contains the information necessary for replication purposes; and it is furthermore uncertain whether it is at all possible to produce a Materials and Methods section that is sufficiently elaborate to make up for a reading situation removed from the original context in which the research was undertaken and the research article written.

8. Conclusion

In the present paper I have analysed the Materials and Methods section of two biotechnology research articles, which were selected by the Head of a Danish research project for discussion in laboratory group meetings. Both articles focused on the genetic makeup of the potato. Incorporating sampling discourse as well as laboratory accounts, the Materials and Methods sections contained a wide variety of authorial traces even if the authors/researchers did not use personal pronouns, epistemic modality or other interpersonal cues in any of the written texts studied. It may be concluded that there was more personality, albeit implicit, in the articles than one might anticipate – a feature common to the two articles. There was thus little variation in the ways in which knowledge was represented, - an observation that cannot, of course, justify any claims about typicality even if both articles reveal something about the social contexts in which they were written. While similarities outrivaled differences in the written texts, it was interesting to notice certain differences between the written texts and a tape-recorded discussion among biotechnology researchers, who made widespread use of epistemic modality, first-person pronouns and evaluative statements. The researchers were thus backgrounded in the written texts, but foregrounded in the oral discussion.

Given these examples of textual variation, my findings raise questions about the construction and mediation of knowledge in scientific discourse. This resonates with Bazerman's (1988: 21) observation about written texts that they 'appear context less and socially meaningless in comparison with spoken language that arises out of the needs of a moment'. The quotation from Bazerman points to one of a number of explanations of why the discussants found the written text difficult to make sense of. By convention, prominence has been given to written documents, which have been taken as true reports of scientific inquiry in the laboratory. But one might wonder why this is so since written text does not necessarily construe reality once it gets filtered through a reader. It therefore seems surprising that the written research article still follows the institutionalised convention of silencing the researcher in spite of the replication requirement imposed on the Materials and Methods section and the changes in social and discursive practices demonstrated in Dressen's work. A further explanation might be, as suggested by Berkenkotter and Huckin (1995, p. 38), that journal editors and reviewers insist on a conventionalised form that fits into the journal format, ignoring that this may be a constraint on the researcher's possibilities to make their ideas accessible and hence on their possibilities to make their research replicable. Accessibility and replication go hand in hand and if scientific research articles are not comprehensible to scientists, then they are even less so to students, translators and journalists who try to disseminate scientific information through the media.

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Appendix 1

The Materials and methods section of the DLS- research article

2.1. RNA extraction and library construction

Field grown potato tuber (var. Kuras) was harvested at the end of flowering, washed in 0.5% sodium dodecylsulfate, cut into pieces and frozen in liquid nitrogen in the field. RNA was extracted from 5 g as described by Scott et al. [12]. Poly(A) mRNA selection (MagneSphere technology, Promega, Madison, WI, USA), and cDNA synthesis (Stratagene) were carried out by standard procedures, except for using a different5´ linker adapter (5´-AATTCGGCTCGAGG). cDNA was size fractionated by gel filtration and cloned unidirectionally into the ZAPII vector. The resulting DNA was packed into phages using Gigapack III Gold (Stratagene). From the initial plating the library was estimated to contain 105 clones. An aliquot of the library was amplified, followed by in vivo excision of the pBluescript SK() phagemid. The average insert size was 1.5 kb.

2.2. DNA sequencing

An aliquot of the excised, amplified library was used for infecting Escherichia coli SOLR cells of OD600 1.0 and subsequently plated on LB agar containing ampicillin. The resulting colonies were picked into a 96 well culture plate and grown for 10 h at 37°C and 200 rpm. Glycerol was added to a final concentration of 15% and a backup plate was created. Plates were stored at 45°C. Polymerase chain reaction (PCR) products suitable for sequencing were generated from 0.5 µl of defrosted bacterial glycerol stock as template and T3-EST1 (AATTAACCCTCACTAAAGGG) and M13-21 (TGTAAAACGACGGCCAGT) as primers (present in the pBluescript vector arms). The PCR included 95°C 3 min, 95°C 30 s, 53°C 30 s, 72°C 105 s for 35 cycles and a final extension at 72°C 7 min. The control of size and quality of the PCR products was performed by gel electrophoresis of a representative number of samples from each plate. Excess primers and nucleotides were removed by enzymatic digestion using 5 U exonuclease I (New England Biolabs) and 0.3 U of shrimp alkaline phosphatase (Amersham Pharmacia), 37°C for 60 min, followed by inactivation of the enzymes at 80°C for 20 min. The resulting PCR product was then used as template for a sequence reaction using 5 pmol of a nested primer (GTGGCGGCCGCTCTAGAA) 38 bp upstream of the cDNA insert, and dye terminator cycle sequencing chemistry. For each reaction, 4 µl of PCR product was used (50-100 ng DNA) in a total reaction volume of 12 µl. Sequencing reactions were subjected to 95°C 20 s, 57°C 15 s, 60°C 1 min for 30 cycles and 60°C for 5 min. These were cleaned by Sephadex G50 (DNA grade, Amersham Pharmacia) in filter plates (Millipore MAHV N45) prior to capillary electrophoretic separation and detection by a MegaBace 1000 (Amersham Pharmacia).

2.3. Sequence processing and analysis

A custom PERL script processed sequence files automatically. This script linked sequence backup, basecalling by Phred (trimming option on, cut-off set to 0.05; CodonCode), discarding sequences shorter than 150 bp, and vector trimming by Cross Match (CodonCode) into one routine. DNATools [13] was used to automatically BLAST and analyze results, build EST submission files for the dbEST (GenBank dbEST BI405291-BI407114), and edit sequences. It was also used to build a searchable flat database containing sequences and BLAST results. BLASTX searches and putative identification were carried out locally because of speed. A 600 bp sequence was blasted against 660,000 non-redundant GenBank protein entries in 25 s using a 1100 MHz AMD CPU with 768 MB RAM. Inverted sequences and sequences originating from E. coli and Lambda inserts were removed. Contigs were built with the edited sequences using Phrap (CodonCode): phrap>readslog.txt-revise_greedy-confirm_score 40-vector_bound 10-maxgap 10.

2.4. Functional analysis of EST sequences

The MIPS functional classification applied to Arabidopsis genes [9,10] was adapted for potato. Translated potato ESTs were sorted into 12 functional groups and an unclassified group by sequence comparison to classified Arabidopsis proteins using an E-value cut-off at 105 [14]. Some were assigned more than one function in agreement with the homologous Arabidopsis proteins. All Arabidopsis protein sequences were downloaded from TIGR in batches of separate functional class [11]. These flat file databases were concatenated into one file, and a BLAST searchable database called At-Class was built with format db.

Appendix 2

The Materials and Methods section of the ABI- research article

MATERIALS AND METHODS

Library Construction

Libraries were generated from mRNA isolated from multiple tissues of potato (*Solanum tuberosum*). All libraries were constructed from potato cv Kennebec, with the exception of the stolon and microtuber libraries, which were constructed from the potato cv Bintje. All libraries were directionally cloned into pBluescript vectors (Stratagene, LaJolla, CA) and after ligation, cloned into SOLR cells (Ausubel et al., 1994). The healthy leaf, sprouting eye, stolon, root, and tuber libraries were constructed in the Steve Tanksley lab. The healthy leaf library was constructed from leaflets and petioles obtained from greenhouse-grown (8-week-old) plants. The sprouting eye libraries were constructed from 2- to 15-mm germinating eyes from Kennebec tubers. The stolon library was constructed from developing axillary buds of potato nodal stem cuttings cultured on a medium that induces tuber formation (Bachem et al., 1996). The microtuber library was constructed using in vitro-grown tubers. The dormant tuber library was constructed from internal tuber tissue (excluding epidermal and bud tissue) that had been stored for 1 month after harvest at 4 C. The root library was constructed from roots grown in vitro on CM medium.

Two libraries were constructed from late-blight pathogen (*Phytophthora infestans*)-challenged leaf tissue. The BLPI library was constructed in the Barbara Baker lab after challenging incompatible leaves with late-blight pathogen US-1 (US 940501; 450,000 sporangia mL_1) in the Biotron (University of Wisconsin, Madison). RNA was isolated from leaf tissue collected at 1, 2, 5, 12, and 24 h post-challenge. The PPC library was constructed in the William Fry lab after challenging leaves with the compatible late-blight pathogen isolate US 940480 (20,000 sporangia mL_1). RNA was isolated from tissue collected at 3, 6, 9, 12, 24, 48, and 72 h after inoculation.

Sequencing Methodology

Clones were grown for 18 h in yeast tryptone media (Biofluids, Rockville, MD). Templates were prepared using the Eppendorf-5 Prime Direct Bind prep kit (Eppendorf, Boulder, CO). The 5_ ends of the cDNA clones were sequenced on ABI 377 or 3700 sequencing machines using standard sequencing methods. Bases were called using either phred (Ewing and Green, 1998; Ewing et al., 1998) or the TraceTuner program (Paracel, Pasadena, CA). Vector and low-quality bases were trimmed using an in-house program.

Computational Methods

EST sequences were trimmed to eliminate vector, adaptor, and lowquality sequences. Sequences sharing greater than 94% identity over 40 or more contiguous bases with unmatched overhangs less than 30 bases in length were placed into clusters. Overlaps based exclusively on lowcomplexity regions were excluded. Each cluster was assembled at high stringency using the Paracel Transcript Assembler (version 2.6.2, http:// www.paracel.com; Huang and Madan, 1999) to produce TC sequences. Alignments containing gaps (or inserts) longer than nine nucleotides were discarded, allowing for the segregation of possible alternative splice forms. Sequences not assembled into a TC were termed singleton ESTs. The TCs and the singleton ESTs were searched against a nonredundant protein database to provide a putative function with a minimum of 30% identity over 20% of the length of the protein required for a TC or singleton EST to be annotated (Quackenbush et al., 2000, 2001). Transposable element sequences of Arabidopsis, potato, and tomato (*Lycopersicon esculentum*; 93, 12, and 99 sequences, respectively) were downloaded from the GenBank as of October 31, 2002. BLASTN (WU-BLAST 2.0, http://blast.wustl.edu; Altschul et al., 1990) was used to identify the presence of transposable elements in the 19,892 TC and singleton EST sequences using a cutoff criterion of E _ _05. Tomato and potato EST sequences were searched using WU-BLAST 2.0 (W. Gish, unpublished data;

http://blast.wustl.edu; Altschul et al., 1990). Potato EST data described in this study are available online (http://www.tigr.org/tdb/potato/plantphysiologypaper /specialgeneindex). Digital analyses of gene expression were performed with the TIGR MultipleExperimentViewer software (version 1.1; Quackenbush, 2001) by using transcript abundance in each TC inferred from the EST frequency for that TC in all seven libraries. Only TCs that were composed of at least six ESTs were used for the cluster analyses. Hierarchical clustering (Eisen et al., 1998) with statistical support for the nodes of the trees, based on resampling the data, was performed. *k* Means clustering (Soukas et al., 2000) with initial calculation of the figures of merit (Yeung et al., 2001) was also performed.

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ABSTRACT

Personality and impersonality in biotechnology discourse

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Key-words
IMRD model, Materials and Methods, genre and discourse analysis, scientific research article, accessibility, implicitness, evaluation

With the emergence of biotechnology, the field account has been replaced by something that we may refer to as a laboratory account – a kind of narrative that constitutes the Materials and Methods section of the IMRD model (introduction, methods, results and discussion). Research focusing on field accounts from geology (Dressen 2002; Dressen and Swales 2000; Swales 2004) has shown that the author is usually 'silenced' in these accounts, and Dressen's research corroborates similar findings by other researchers (see e.g. Myers 1990). Following Dressen (2002), this paper explores authorial traces in the Materials and Methods sections in two scientific research articles and compares the results with data from a discussion of one of these articles by a Danish research group. It is found that while the Materials and Methods sections are characterized by impersonality, the oral discussion foregrounds personality and at the same time demonstrates how the impersonal written texts cause comprehension problems - even to practitioners - with adverse implications for the replication of results.
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