"Do I know what I don't know?" The Communication of Non-Knowledge and Uncertain Knowledge in Science

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Abstract Types of knowledge, the linguistic forms they take, and issues concerning the transfer of knowledge constitute major topics in contemporary LSP research. A new trend in *non-linguistic* research is to focus on types of non-knowledge and their scientific and social relevance. Up to now, however, *linguistic* questions such as the following have been neglected: How do we cope with non-knowledge and uncertain knowledge in texts? What are the linguistic forms that enable us to distinguish between certain knowledge, uncertain knowledge and non-knowledge? The aim of this paper is to situate open linguistic issues within the field of research on ignorance and uncertainty and to outline a possible linguistic framework for this topic. The paper therefore discusses the communication of uncertain knowledge and non-knowledge in scientific texts from the following perspectives:

What are the open linguistic issues in this field? These may include, for example: Which linguistic forms are used to discuss and evaluate non-knowledge and in what ways are they contingent upon specific genres, contexts and cultures? What are the conversational and social consequences for scientific texts and academic discourse? What are the researchers' own commitments and in what ways do they anticipate possible future knowledge? Which methods and linguistic categories can help us to close this gap in LSP research? These may include, for example, approaches adopted within stylistics and textual linguistics, discourse analysis, and cognitive linguistics.

Keywords knowledge, uncertainty, cognitive linguistics, discourse analysis, stylistics, scientific texts

1 Introduction

Types of knowledge, the linguistic forms they take, and issues concerning knowledge transfer are key topics in contemporary research relating to LSP (for German research see, for example, the book series *Transferwissenschaften*, edited by Gerd Antos and Sigurd Wichter, published by Peter Lang). Due to the emphasis placed in our society on pursuing and producing ever more knowledge, the importance of learning to deal with non-knowledge is often forgotten. The study of types of non-knowledge and their scientific and social relevance has been undertaken predominantly by non-linguistic research groups consisting, for example, of sociologists and philosophers (e.g. Böschen/Wehling 2004, Proctor/Schiebinger 2008); as a result, the linguistic perspective has generally been absent. Key questions for linguistics might include the following: How do we cope with non-knowledge and uncertain knowledge in texts? What are the linguistic forms that enable us to distinguish between certain knowledge, uncertain knowledge and non-knowledge? What impacts do genres, contexts, languages and cultures have on the communication of uncertain knowledge and non-knowledge?

Basing our preliminary observations on an interdisciplinary pilot project (linguistics, philosophy and climate change research) being conducted at the Technische Universität (TU) Darmstadt, we will discuss the role and relevance of non-knowledge and uncertain knowledge

in selected texts as well as attitudes towards non-knowledge in scientific discourse. We will give examples not only of linguistic forms expressing non-knowledge but also of methodological approaches suited to work in this new research area in LSP. This article is to be understood as work in progress: our primary aim is to introduce this new field of research into linguistics and to offer an initial idea of potential outcomes.

2 Non-knowledge – uncertain knowledge

Non-linguistic research has developed a variety of definitions around the phenomenon of 'not knowing'. Ravetz (2006)[1], for example, identifies different types of knowledge according to the level of certainty and awareness given. The 'known known' refers to knowledge – albeit knowledge can be uncertain or confusing due to its specialization and fragmentation. The 'known unknown' is a form of non-knowledge, or still uncertain knowledge, that refers to established gaps in and limits of knowledge. Ravetz contrasts this latter type with the 'unknown known'. This type of knowledge is familiar but not accepted (cf. Knoblauch/ Schnettler 2005: 33). It may include, for example, areas of consensus or schools of thought which, for diverse reasons, are unable to become established as generally accepted. Examples are 'alternative' knowledge such as midwives' knowledge or reiki (laying on of hands), which is not recognized within medicine taught at universities, or indeed lay knowledge exchanged discursively on the internet, which is neither acknowledged let alone accepted as valid in expert circles. Finally, Ravetz identifies the 'unknown unknown', meaning that gaps in knowledge are not yet clearly apparent, have not yet been investigated, or indeed have not yet been accepted as such: the boundaries of the non-knowledge are unknown. In addition to these different types of non-knowledge, Ravetz also uses the term 'ignorance' along with the expression 'ignorance of ignorance' (or 'ignorance-squared'), by which he means ignoring someone else's or one's own ignorance (cf. Ravetz 1993: 157). Ravetz's definitions can be usefully complemented by those offered by Wehling (2003: 125; 2004: 72 f.), who distinguishes additionally between 'deliberate', 'intended' and 'unintentional' non-knowledge. Neuser (2000: 88 ff.) defines ignorance as either something which can never be known or something which is only provisionally unknown.

Proctor (2008: 3) lists several kinds of ignorance: 'ignorance as *native state* (or resource), ignorance as *lost realm* (or selective choice), and ignorance as a deliberately engineered and *strategic ploy* (or active construct)'.

Gross (2007) distinguishes between six types of knowledge, or states of 'not knowing'. Each category points to a different aspect of 'not knowing', such as the limits of knowledge (ignorance) and a total lack of knowledge (nescience). Overlaps are possible.

Knowledge	A belief that was justified as true and is accepted by a group or certain individuals studied by a sociologist.
Ignorance	Knowledge about the limits of knowledge in a certain area; increases with every state of new knowledge.
Non-knowledge	Knowledge about what is not known but taking it into account for future planning.
Negative knowledge	Knowledge about what is not known, but considered as unimportant or even dangerous – can lead to non-knowledge.
Extended knowledge	Based on planning and / or research with non-knowledge – can also lead to new non-knowledge by uncovering limits of the newly gained knowledge.
Nescience	Lack of any knowledge: prerequisite for a total surprise beyond any type of anticipation – can lead to ignorance and non-knowledge, but belongs to a different epistemic class from the above terms.

Figure 1: Categorization of knowledge, different unknowns and extended knowledge (Gross 2007: 751)

As this indicates, there are several different terms available to describe the various facets of knowledge and non-knowledge. Closely related to non-knowledge is the term 'uncertainty', which is semantically fuzzy and can refer to any number of positions along the continuum between knowledge and non-knowledge. Other relevant terms associated with knowledge and non-knowledge include 'meaning' and 'faith'. These latter two are not crucial for this preliminary overview, but they should not be neglected in a more detailed discussion of the communication of non-knowledge.

The largely philosophical and sociological difficulties associated with defining non-knowledge have to do with the ways in which the relationship between (future) knowledge and non-knowledge is conceptualized. One possible and well-known approach assumes that, as present knowledge increases, future non-knowledge will decrease; this can be described as the case of the 'not-yet-known' (Wehling 2006: 256; Neuser 2000: 89 f.). It implies that everything could be discovered given enough time and money (cf. Keil/Stieß 2007: 195). Another, contrasting, approach is based on the conviction that as knowledge increases, non-knowledge also increases. This approach exemplifies the expectation that non-knowledge is continuously expanding and that the borders of knowledge are continuously being extended: even as science produces certain knowledge, it also systematically generates uncertain knowledge. Science always moves at the edges of non-knowledge (cf. Engel/Halfmann/Schulte 2002: 10). A third approach considers non-knowledge to be independent of future knowledge, i.e., it is knowledge which, from today's perspective, is considered to be unattainable. What is meant here is that some things cannot be known *in principle* (cf. Wehling 2006: 256) for reasons of, say, complexity or the unpredictable influence of innovation or social change (cf. Keil/Stieß 2007: 195).

    In the following scheme, we will use the English term *non-knowledge* in a wider sense than Gross (2007) in order to try to include – and to leave open – all possible facets of the term.

3 Significance of non-knowledge and its attendant problems

Trust in the problem-solving qualities of key technologies is very high at the present time and in our globalized society. A key aim of scientific research is to produce the necessary insights

and knowledge on which to base academic, political, social, and individual decisions. However, knowledge can only be partial knowledge in science, as Engel/Halfmann/Schulte (2002: 9) note: the more one knows, the more one becomes aware of areas of non-knowledge. For this reason, it is important for scientists and academic researchers to take account of non-knowledge and uncertain knowledge which might be included in models, theories and schools of thought. Scientists must learn how to deal responsibly with non-knowledge for the following three reasons:

1) Scientific research and technological systems manage increasing amounts of **complexity** and can also introduce new levels of complexity. What kind of knowledge do these systems produce and what kind of unknowns need to be acknowledged?

2) There is a well-established tendency to present research findings as a success story – not to mention non-scientists' expectations of scientists that they should do so. How can such stories be told in a more nuanced way, despite the pressure to succeed, and what strategies are available for maintaining **scientific credibility** and meeting reasonable expectations?

3) Perhaps more pressingly, science (e.g. risk governance, climate modeling, and toxicology) cannot wait until complete and perfect data are available to feed into their **modeling**. What practices exist for incorporating acknowledged data gaps, uncertainty and ignorance into summary presentations of scenarios and trends?

LSP research should consider and discuss non-knowledge and uncertain knowledge for several reasons. First, non-knowledge is relevant to and forms the basis of different types of text. It is deliberate, for example, in calls for tenders or papers, in project designs, and in funding applications. It is assumed to varying degrees, for example, in polemic pamphlets and popular science texts. Finally, it may be either deliberate or non-deliberate and implicit in potentially all kinds of (intra)scientific texts. LSP presents knowledge through wording and textual structure. Its aim is to handle, store and transfer knowledge reliably and clearly. Technical terms may encompass complex interconnections, but they also – of necessity and essentially – filter out non-knowledge. Coining terms in scientific and academic discourse entails a reduction in complexity as a means of processing information economically. Here, reducing complexity means hiding or suppressing non-knowledge and uncertain knowledge and fixing the term to a specific meaning. However, although a term may contain a heightened complexity, the various implications are clear only to experts (cf. Budin 1996: 49). Scientists may be able to recall or reconstruct the non-knowledge or uncertain knowledge implied in the term, but they tend not to do this in transfer situations or in scientific texts – at least not unless this is an explicit component of the work or topic at hand. Meanwhile, the general public generally does not take account of the fact that uncertainty or non-knowledge is something scientists have to deal with all the time.

The key issues for LSP research are the ways in which scientists represent and communicate non-knowledge in their academic environment and in the public sphere, whether they discuss it openly, and which linguistic forms and rhetorical strategies are used in which texts. Furthermore, it is important to consider how experts act in conditions of uncertainty vis-à-vis future eventualities in politics and society. The central question is whether or not it is possible to identify linguistic markers – or at least significant portions of text from different genres – as means of flagging up temporary knowledge gaps as well as more persistent knowledge constraints.

4 Linguistics and non-knowledge

The main topic addressed in this section is the communication of non-knowledge or uncertain knowledge in academic texts and their associated discourses. The anticipation of possible future knowledge and researchers' own commitments will be discussed along with a presentation of some linguistic forms which may point towards or paraphrase non-knowledge or uncertain knowledge.

4.1 The researcher's own commitments

As Jäger (1996: 74) notes, German experts generally tend to put little effort into making their specific knowledge (including their non-knowledge) transparent and understandable to lay people. Instead, experts argue often that lay people should exercise their autonomy to gain access to and understanding of whatever they want to know. This view, apparently held by many experts, neglects the fact that outsiders are usually unable to follow complex scientific discourse, so that even formulating questions poses a real challenge. The frequent absence of transparency leads not only to a lack of knowledge but also to a lack of non-knowledge – in other words, lay people do not know what they do not know (cf. Göpferich 2002: 1 f.). Possible reasons for the lack of explanatory effort on the part of some scientists might be that neither writing in a popular way nor writing about non-knowledge are entirely respectable or reputable activities in scientific circles. Additionally, it can be assumed that communicating about non-knowledge is subject to 'external' exigencies, such as a scientist's reputation, the pressure they are under with regard to publishing, using their time and furthering their career (cf. Beck-Bornholdt/Dubben 2008: 97 f.; 192 f.), competition between different schools of thought, third-party funders, and the expectations of policy makers. Policy, for example, demands first and foremost reliable, safe facts and pronouncements. Suggestions of knowledge gaps and potential uncertainties are inconvenient for both political and practical reasons.

    This indicates, first, the kinds of challenges scientists face, such as meeting the demand for factual certainty as opposed to responsibly handling and communicating uncertainties (cf. Keil/Stieß 2007: 193). In addition, though, these (often conflicting) demands highlight a particular risk, namely, that uncertain knowledge might steadily become transformed into supposedly certain knowledge. In consideration of this, one task for linguistic research must be to focus on the transfer of non-knowledge. This would constitute a key complementary component to the work of the German research network 'Language and Knowledge' (*Forschungsnetzwerk Sprache und Wissen*, http://www.suw.uni-hd.de/) and the research group around Antos and Wichter (book series *Transferwissenschaften*), who are working on knowledge transfer.

4.2 Conversational and social consequences for scientific texts and academic discourses

As mentioned above, scientists face social expectations and are often under pressure to provide answers to urgent questions. Thus their answers might necessarily be based at times on uncertain or partial knowledge. In these cases it seems that non-knowledge or uncertainty is occasionally concealed or glossed over. At the same time, non-knowledge and uncertainty are often rendered functional in different (con)texts for different purposes, e.g. as a starting point or basis for research in funding applications or project designs. In these cases non-knowledge or knowledge gaps must be made explicit in order to show that research is necessary

(cf. Stocking/Holstein 1993: 191). Furthermore, non-knowledge or assumed knowledge is explicit in order to strengthen or argue for/against certain perspectives, not only in science but also in the media for political, publicity-seeking or entertainment reasons (cf. Wehling 2006: 254 f.; Stocking/Holstein 1993: 189 f.). Stocking/Holstein (1993) emphasize – in agreement with Myers (1990) – that ignorance is not only a gap in knowledge but can often be a construct deriving from differing claims. They identify a variety of rhetorical strategies used by scientists and journalists in relation to these claims of ignorance, used variously to protect their own interests or to point to knowledge deficits in related research papers.

At the same time the impression remains that, if non-knowledge is not rendered useful for any obvious reason (including self-interest), it is often erased from the picture or at least is not communicated clearly (cf. Wynne 2002: 469). For example, the titles, abstracts and main texts of essays have differing lengths and textual functions. This convention may tempt the author(s) to express an issue succinctly in an abstract or title, without any indication of uncertainty, while taking a more cautious approach in the main text, which may not always be read (or not with sufficient attention to detail). In a medical text from 1992, for example, the main text states: 'These data per se do not show accelerated proliferation, but they agree with the hypothesis that accelerated proliferation occurs and is important in determining outcome.' In the abstract, however, the author writes: 'These data support the hypothesis that proliferation (possibly accelerated) of tumor clonogens during treatment influences the outcome.' And in the title of the contribution he puts it even more succinctly: 'New evidence for accelerated proliferation' (Beck-Bornholdt/Dubben 2008: 147 f.).

This way of handling knowledge triggers undesirable consequences, because knowledge that is currently taken to be certain can hardly be evaluated properly without an account of relevant gaps in knowledge. The confession that knowledge gaps exist can lead to new perspectives on knowledge otherwise considered safe (cf. Stocking/Holstein 1993: 187 f.). Due to the use of non-specific, vague expressions (e.g. modal constructions involving *can, could, may, possibly, probably, not necessarily* and so forth), readers are left confused and problems arise with regard to interpretation (cf. Beck-Bornholdt/Dubben 2008: 191 f.). This can lead to misunderstandings or even to falsified representations of the world, based in part on scientific results.

In order to prevent these problems occurring it is important that every scientist reflects not only on their ethical and moral independence and responsibility, but also on the following crucial issues relating to scientific norms of textualization:

– What is the question and what is the expected knowledge outcome?
– How should knowledge from other sources be dealt with (e.g. in the context of scientific texts), and with the complexity of methods, substances, and measuring instruments?
– On which methods, data, and insights is the knowledge presented based? To what extent can it be presented as 'certain'? Where and why does knowledge remain uncertain or limited and how should this be emphasized in the manner of its presentation?
– Which conclusions should be drawn regarding uncertain knowledge and non-knowledge? How should authors deal with readers' expectations with regard to the transfer of certain and reliable practical knowledge for decision making?

4.3 Linguistic forms

One of the aims of our linguistics project is to detect those linguistic forms and rhetorical strategies which indicate non-knowledge and uncertain knowledge and to discuss how they vary across different scientific and popular text genres and between different parts of a given text. We are compiling various corpora (e.g. scientific papers, journalistic articles, talks and discussions at scientific conferences, predominantly in the German language) in accordance with a number of specific research questions. The following examples are preliminary case studies aimed at identifying possible methods for and outcomes of a linguistic approach to the communication of non-knowledge. These texts were chosen to represent four different genres addressing different audiences (scientists vs. public/lay people). Although these short excerpts preclude the possibility of revealing differences between the different passages of text, it is nonetheless crucial to consider the specific function of different parts of a text according to its genre, such as the abstract, introduction, or discussion in the case of a scientific text. The underlined expressions show different modes in German that point towards uncertainty or non-knowledge, always within the context and the proximate textual environment (co-text):

Example 1: scientific article[2]

Führt die steigende Nachfrage aus dem energetischen Bereich <u>künftig</u> in anderen Sektoren zu einer Verknappung von Rohstoffen<u>? Und wenn ja, was sind die Folgen: werden dann</u> in diesen Sektoren nachwachsende durch fossile Rohstoffe ersetzt, <u>wird zukünftig</u> Holz aus Sibirien nach Mitteleuropa importiert, <u>werden</u> in Deutschland extensiv genutzte Flächen zu Anbauflächen umgewandelt<u>? Um</u> gesamtwirtschaftliche <u>Ziele</u> des Klimaschutzes <u>zu erreichen, müssen</u> solche <u>möglichen Folgewirkungen berücksichtigt werden</u>.

Example 2: invitation to tender[3]

<u>Um</u> den <u>Herausforderungen</u> der regionalen und globalen Veränderungen <u>begegnen zu können</u>, werden <u>innovative Konzepte</u> und Strategien eines Landmanagements sowie die hierfür <u>erforderlichen Wissensgrundlagen</u>, Technologien, Instrumente und Systemlösungen <u>benötigt</u>. Mit der vorliegenden Fördermaßnahme <u>soll daher Forschung initiiert werden</u>, die einen <u>Beitrag</u> zu einem nachhaltigen Landmanagement gemäß den Zielen der Nachhaltigkeitsstrategie und den Klimaschutzzielen der Bundesregierung <u>leistet</u>. Die Fördermaßnahme baut auf dem Forschungsrahmenprogramm „Forschung für die Nachhaltigkeit" (FONA) des Bundesministeriums für Bildung und Forschung auf und schlägt eine Brücke zu den <u>zukünftigen Forschungsfeldern</u> des BMBF.

Example 3: popular science article[4]

Damit <u>stellt sich</u> jedoch <u>die Frage</u>, warum Sprache überhaupt entstanden ist. Derek Bickerton von der Universität von Hawaii stellt in seinem Buch „Language and Species" die <u>Vermutung</u> auf, daß die Sprache ein Nebenprodukt der Entwicklung des Gehirns <u>sei</u>. [...] Bickerton <u>spekuliert</u>, daß uns unkultiviert aufwachsende Kinder eine Ahnung von dieser Primitivsprache <u>vermitteln könnten</u>, weil sie in den Jahren, in denen sich das syntaktische Sprechen normalerweise herausbildet, isoliert waren. [...] Eine andere Anpassung bestand <u>wohl</u> in der Fähigkeit, Lautungen zu dekodieren. [...] <u>Anscheinend</u> wird dieser Nachteil

aufgewogen durch die verbesserte Artikulationsfähigkeit [...]. Der Stimmapparat der Ne-
andertaler ähnelte dagegen – <u>jedenfalls nach Liebermanns Rekonstruktion</u> aufgrund des
fossilen Materials – dem der Affen.

Example 4: journalistic text[5]

„Der Boden als Faktor im Erdsystem ist ein echtes <u>Stiefkind der Forschung</u>. Diese <u>Lücke
wollen wir schließen helfen</u>“, sagt Markus Reichstein, der am Max-Planck-Institut für Bio-
geochemie in Jena eine Arbeitsgruppe leitet: „Ich glaube, wir haben den Boden als Kli-
mafaktor <u>bislang stark unterschätzt</u>.“ [...] Messtechnisch haben die Forscher nicht selten
<u>Neuland beschritten</u>. „Eine umfassende Bodeninventur <u>wurde</u> in der Geschichte <u>einfach
noch nicht gemacht</u>“, sagt Marion Schrumpf. <u>Extrem rar</u> sind etwa Daten von Waldböden.
„Die Forstwirtschaft hat sich zwar für den Baumbestand <u>interessiert</u>, aber <u>nicht</u> für den
Boden, auf dem er wächst“, so die Forscherin. Die <u>wenigen vorhandenen Daten</u> stammen
aus der Landwirtschaft.

In this small corpus of texts we found the following linguistic forms which express or imply
non-knowledge in a certain context:

- expressions of stating, meaning and believing (*<u>stellt sich [...] die Frage, Vermutung, spekul-
ieren, eine Ahnung vermitteln</u>*)
- directive speech act types to mark desiderata, e.g. questions (*<u>Und wenn ja, was sind die
Folgen [...]?</u>*) and requests/demands, imperative infinitive constructions (*<u>Um [...] zu erre-
ichen</u>*, *<u>müssen</u>* , *<u>Um den Herausforderungen [....] begegnen zu können, werden [...] erforder-
lich</u>*);
- forms of modality, modal verbs (*können, sollen, müssen*), modal words (*mögliche, erforder-
lich, anscheinend, wohl, <u>jedenfalls nach</u>*) and syntactic modality (subjunctive) (it is neces-
sary to distinguish here between objective and subjective modality);
- ways of expressing temporality in order to refer to the future or to something anticipated
(*künftig/zukünftig, noch nicht, <u>bislang</u>*);
- forms of negation (*noch nicht gemacht, zwar für den Baumbestand <u>interessiert, aber nicht
für den Boden</u>*);
- relevant wordfields/isotope levels such as 'new, novel, innovative' (*innovative, initiieren*),
'unknown, open, missing, absence' (*Herausforderungen, Frage, fehlen, Lücke, extrem rar,
wenige vorhandene Daten*); explicit expressions of 'knowledge, research' (*erforderliche
Wissensgrundlagen, Forschung, Forschungsfelder*) and (cognitive) results/output backup
(*Ziele, Konzepte, Herausforderungen begegnen, Beitrag leisten*);
- rhetorical figures such as metaphors, idioms, anthropomorphs (*<u>Stiefkind der Forschung</u>*,
Neuland betreten).

These excerpts show that there are notable differences between scientific and non-scientific
genres, mainly in the use of idioms and metaphors, modal verbs and verbs of saying and think-
ing, or believing. Non-scientific texts seem to associate indications of non-knowledge more
with evaluation and personalization than scientific texts.

This list of expressions and forms is to be understood as a starting point for more system-
atic study and not as straightforward linguistic markers of non-knowledge. The specific (situ-
ational and genre-based) context of all these expressions is highly relevant for any interpreta-

tion, so that we need to ask whether it is possible to identify a systematic relationship between specific linguistic forms and the representation of uncertain knowledge or non-knowledge.

5 Sketching a possible framework

In the context of two PhD theses we are currently focusing on two main topics: the stylistic representation and evaluation of non-knowledge in journalistic texts, and the impact of non-knowledge on scientists' image management in scientific discourse.

In addition, we are interested in disciplinary, cultural and historical perspectives on non-knowledge, for example: Is non-knowledge or uncertain knowledge presented and interpreted differently depending on genres, disciplines and languages? To what extent are verbalization strategies and the handling of non-knowledge culturally influenced or shaped? And how do these strategies change over time (compare, for example, the Enlightenment period with the 21st century)? It would also be interesting to explore how scientists deal with non-knowledge in scientific discourse as well as the differences between written and spoken language. Even if this is only a small sample of questions, it shows that a range of methodological options arise depending on the research interests and corpora available. Currently, there are no linguistic theories or models dealing explicitly with non-knowledge and uncertain knowledge. Thus this chapter serves as a methodological inquiry aimed at exploring which existing framework could be used in order to address our research interests. We can refer here to only a few sample references and currently preferred models, since it would go beyond the scope of this paper to provide a detailed overview of approaches from cognitive linguistics, discourse analysis, research in text production and writing, and stylistics. The concepts and approaches cited (mainly from current German research) refer to important previous studies conducted by researchers such as Charles Fillmore, Ronald W. Langacker, Michel Foucault, Teun A. van Dijk, John Hayes/ Linda Flowers and others.

Cognitive linguistics
Language and knowledge are linked by cognition: Knowledge is cognitively processed, mentally represented and stored. Cognitive linguistics describes and explains these mental language structures and processes, which are fundamental to the acquisition and use of knowledge. Cognitive strategies enable information to be understood and communicated. However, what happens if it is not knowledge but non-knowledge that is at issue? How is non-knowledge mentally represented – if it is represented at all?

Current research in cognitive grammar assumes that in order to be stored or communicated, all relevant aspects of knowledge have to be represented as symbolic entities (cf. Ziem 2009: 177). These symbolic entities are complexes of knowledge embodied in wording and phrasing, in semantic and grammatical structures (cf. ibid.: 176). Information is processed by means of categorization and schematization (cf. ibid.: 175), whereby the different forms are distinguished according to different levels of abstraction: there are *image schemas, frames* or *cognitive domains*, and *mental spaces* (cf. ibid.: 185–191).

The following questions thus arise: How does cognitive linguistics account for uncertain knowledge and non-knowledge, and what are the cognitive categories associated with them? We need to take account of non-knowledge and uncertain knowledge because, like knowledge, it is relevant for understanding and acting. The question is whether such non-knowledge can have a symbolic unit if the author is not aware of its presence, or whether it is more properly

represented as a terminological gap or 'empty space'. If non-knowledge is mentally represented in some way, it must be possible to draw a cognitive (non-) knowledge map (cf. Zehr 1990: 153, see also Stocking/Holstein 1993: 191) which shows where further research is necessary.

Discourse analysis

Another possible route by which one might analyze the communication of ignorance is discourse analysis. Discourse analysis not only reveals linguistic rules but also seeks to identify what are the current typical ways of thinking and speaking about the world (cf. Warnke/ Spitzmüller 2008: 15). Scientific discourses address topics not only through a process of 'claims making' (cf. Stocking/Holstein 1993: 188); they also and always exclude knowledge.

Knowledge can be seen as a discursively negotiated and collectively accepted good (cf. Warnke 2009: 114). It is therefore sensible to ask to what extent non-knowledge, in the sense of unacknowledged knowledge, is a result of communicative and institutional power structures and to what extent it is dependent on the influence of interest groups (cf. Stocking/Holstein 1993: 188 f.). Warnke and Spitzmüller (2008) have developed a multilevel model of discourse analysis which combines text and cognition linguistic parameters and is therefore readily applicable to the interface between language and knowledge (model in Warnke/Spitzmüller 2008: 44). It also considers an intratextual level (e.g. propositions and implications, wording and style, text structure) and a transtextual level (e.g. different relations between texts) as well as meta-dimensions such as power and ideology, and the roles and (re)actions of those involved in the discourse. The conditions of textual production and the impact of the media concerned can be included in the analysis as well as the interests of participants in the discourse as a whole (cf. Warnke/Spitzmüller 2008: 32). In the context of non-knowledge, discourse analysis is not only interesting in terms of the linguistic representation of non-knowledge but also in terms of differences in the degree of its acceptance in different types of text and also in different parts of a text (e.g. abstract, introduction, discussion, summary). The question of how scientists cope with (their) ignorance in the context of scientific discourse, given the attendant difficulties outlined in section 4.1 above, can also be addressed within this model.

Research in text production and writing

Research in text production and writing offers criteria which are applicable to the communication of non-knowledge. Up to now research has dealt with writing processes only from the perspective of knowledge processing. This includes the didactically oriented writing model developed by Göpferich, in which the processing of information is a basic concern: Information must be activated in the long-term memory or found in external sources; it must be filtered, transformed and adapted so that it fits the writing task. Knowledge is selected, brought into sequence, and expressed in a phrase; it is constantly revised and examined (cf. Göpferich 2002: 250). However, it would be interesting to see how non-knowledge is processed in these different phases of production and how reflection on non-knowledge can be made useful and integrated into these processes. One of the challenges in non-knowledge research is to identify what constitutes an appropriate representation of non-knowledge and uncertain knowledge in texts. Text production and reception can offer criteria based on which knowledge can be communicated in such a way that the level of certainty and uncertainty is still clear and traceable in transfer situations – which should be a general goal if science is to retain its credibility.

According to Jakobs the reason for the re-evaluation of knowledge is the prevalence of increasing text production tasks (cf. Jakobs 2008: 257). Knowledge must be recorded, described

and distributed (ibid.). In order to represent knowledge accurately and clearly the writer must consider several factors, e.g. the writing task, the text's function and intention, and addressees (see e.g. ibid.: 264). In addition to the factors that influence Jakobs' writer, we might also consider Hayes' types of knowledge, which the writer has to activate and recall (Hayes 1996: 4): knowledge about the topic, about linguistic norms, and about genre, for example. According to Göpferich (2002: 250) knowledge about hardware and software use, quality criteria and knowledge about information deficits must be added to this list.

This last point is crucial for our linguistic approach to non-knowledge because it shows that the writer must at least be aware of his or her knowledge gaps in order to manage research and writing.

Stylistics

We can also approach non-knowledge communication by means of stylistics. Marked linguistic forms and the valuation of non-knowledge can be examined with regard to their content and reference, their communicative function and their rhetorical effect in texts (see section 4.3 above). Today, pragmatic and communicative views are predominant in stylistic research; such views seek to include the social dimension of style, which may be of a pragmatic, social or poetic-aesthetic kind. These views are based on the recognition that linguistic choice in formulation processes is limited by the context, while linguistic forms tell us something about the speaker, his/her attitude towards the world and the knowledge being communicated, and about their communication partner. Semiotic approaches also include image and speech design and seek to interpret style as an entity (see, in particular, Fix 2001, 2004, 2007 and Sandig 2006; see also the essays in Jakobs/Rothkegel, eds., 2001 and Neuland, ed., 2006). Style can describe not only the *how*, that is, the specific form of verbal action expressed in a text and through language, but also the *what*, i.e. secondary information about, for example, the writer's self-presentation.

Using stylistic criteria helps us to answer one of our main questions, namely, how is it possible to deal responsibly with non-knowledge in a context of pro-active argumentation in order to secure credibility and generate reasonable expectations.

The aim of future linguistic research into the communication of uncertain knowledge and non-knowledge should be to combine all these methodological facets into a single integrative approach. Furthermore, interdisciplinary co-operation with philosophers and sociologists seems useful if not necessary.

6 Prospects

If non-knowledge, uncertain knowledge, and knowledge gaps are considered to be important elements of science, and if it is acknowledged that they help to offer new perspectives in scientific research, then they should also be communicated. This presupposes the development of a new form of linguistic sophistication, especially in LSP research, including greater awareness and a more conscious approach to handling non-knowledge, both for recipients and producers of scientific texts. This is a relevant topic not only for LSP but also more generally for research on knowledge transfer. The misuse of knowledge to back up political and economic interests is another closely associated problem in communication between the scientific community and the public (see the impressive studies by Oreskes/Conway 2010).

More specific objectives for improving professional communication skills and linguistic sophistication – based on Engberg and Janich's model (Engberg/Janich 2007:223) – might be a competence in contextualization along with creative, trans-subjective and meta-communicative competence. These enable the reader to solve interpretation difficulties, to transfer knowledge to new situations, to handle different varieties and registers used by others, to anticipate others' perspectives, and to reflect on grammatical, semantic and pragmatic norms (cf. ibid.: 218–222).

It would be desirable for scientists – especially in such far-reaching fields as climate engineering, nanotechnology, toxicology and risk governance – to act responsibly by communicating knowledge gaps, uncertain knowledge, and potential risks more clearly in academic and in public, or social, discourse. Moreover, relevant professional norms of communication and speech act models should be developed on the basis of knowledge about discursive mechanisms. Associated with this is the need to develop specific competence in writing professional texts, aimed at facilitating non-experts' comprehension of texts, transparency in science and, not least, scientists' integrity.   •

Notes

[1] Ravetz bases his terminology on a speech by Donald Rumsfeld.

[2] Extract from: Liselotte Schebek/Witold-Roger Poganietz: Potentiale nachwachsender Rohstoffe vor dem Hintergrund konkurrierender Nutzungen, in: Aktuelle Wochenschau der GdCh, Woche 51, 2008, http://www.aktuelle-wochenschau.de/2008/woche51/woche51.html

[3] Extract from: BMBF-Ausschreibung zum nationalen Forschungsprogramm „Nachhaltiges Landmanagement", 24.10.2008, www.bmbf.de/foerderungen/13138.php

[4] Extract from: Spektrum der Wissenschaft Dossier 1/2000: „Ist der Mensch zum Sprechen geboren?" by Philip E. Ross, p. 13

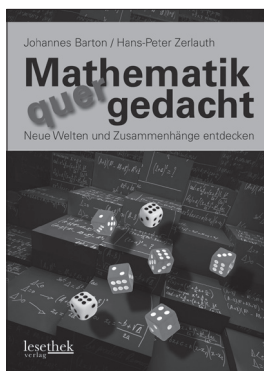[5] Extract from: MaxPlanckForschung 3.2009: „Klima, das im Boden steckt" von Cornelia Reichert, S. 81–87

Literature

Beck-Bornholdt, Hans-Peter/Dubben, Hans-Hermann (2008): *Der Hund, der Eier legt. Erkennen von Fehlinformation durch Querdenken*. Vollst. überarb. und erw. Neuausgabe. Reinbek bei Hamburg: Rowohlt.

Böschen, Stefan/Wehling, Peter (2004): *Wissenschaft zwischen Folgenverantwortung und Nichtwissen. Aktuelle Perspektiven der Wissenschaftsforschung*. Wiesbaden: VS Verlag.

Budin, Gerhard (1996): *Wissensorganisation und Terminologie. Die Komplexität und Dynamik wissenschaftlicher Informations- und Kommunikationsprozesse*. (Forum für Fachsprachen-Forschung 28). Tübingen: Narr.

Engberg, Jan/Janich, Nina (2007): „Über die Komplexität fachkommunikativer Sprachkompetenz und ihrer Beschreibung." *Studien zur Rechtskommunikation*. Hrsg. Dorothee Heller/Konrad Ehlich. Bern et al.: Lang, 209–234.

Engel, Christoph/Halfmann, Jost/Schulte, Martin (2002): *Wissen, Nichtwissen, Unsicheres Wissen*. (Common goods: law, politics and economics 8). Baden-Baden: Nomos.

Fix, Ulla (2001): „Zugänge zu Stil als semiotisch komplexer Einheit. Thesen, Erläuterungen und Beispiele." *Perspektiven auf Stil*. Hrsg. Eva-Maria Jakobs. (Reihe Germanistische Linguistik 226). Tübingen: Niemeyer, 113–126.

Fix, Ulla (2004): „Stil gibt immer etwas zu verstehen. Sprachstile aus pragmatischer Perspektive." *Der Deutschunterricht* 1, 41–50.

Fix, Ulla (2007): *Stil – ein sprachliches und soziales Phänomen*. Berlin: Frank und Timme.

Göpferich, Susanne (2002): *Textproduktion im Zeitalter der Globalisierung. Entwicklung einer Didaktik des Wissenstransfers.* Tübingen: Stauffenburg.

Gross, Matthias (2007): "The Unknown in Process. Dynamic Connections of Ignorance, Non-Knowledge and Related Concepts." *Current sociology* 55; 5; 742–759.

Hayes, John R. (1996): "A New Framework for Understanding Cognition and Affect in Writing." *The Science of Writing. Theories, Methods, Individual Differences, and Applications.* Hrsg. C. Michael Levy/Sarah Ransdell. Mahwah (NJ), 1–27.

Jäger, Ludwig (1996): „Expertenkultur und Sprachkultur. ‚Innersprachliche Mehrsprachigkeit' und das Problem der Transparenz des Expertenwissens." *Öffentlicher Sprachgebrauch. Praktische, theoretische und historische Perspektiven. Georg Stötzel zum 60. Geburtstag.* Hrsg. Karin Böke et al. Opladen: Westdeutscher Verlag, 68–76.

Jakobs, Eva-Maria (2008): „Textproduktion und Kontext: Domänenspezifisches Schreiben." *Textlinguistik. 15 Einführungen.* Hrsg. Nina Janich. Tübingen: Narr, 255–270.

Jakobs, Eva-Maria/Rothkegel, Annely (Hrsg.) (2001): *Perspektiven auf Stil.* (Reihe Germanistische Linguistik 226). Tübingen: Niemeyer.

Keil, Florian/Stieß, Immanuel (2007): „Wissen, was wir nicht wissen: Umweltforschung als gesellschaftlicher Lernprozess." *Ökologische Perspektiven für Wissenschaft und Gesellschaft. Schwerpunkt Umweltforschung* 16/3, 193–199.

Knoblauch, Hubert/Schnettler, Bernt (2005): „Prophetie und Prognose. Zur Konstitution und Kommunikation von Zukunftswissen." *Gegenwärtige Zukünfte – Interpretative Beiträge zur sozialwissenschaftlichen Diagnose und Prognose.* Hrsg. Ronald Hitzler/Michaela Pfadenhauer. Wiesbaden: VS Verlag, 23–44.

Myers, Greg (1990): *Writing biology. Texts in the social construction of scientific knowledge.* Madison: University of Wisconsin Press.

Neuland, Eva (Hrsg.) (2006): *Variation im heutigen Deutsch. Perspektiven für den Sprachunterricht.* (Sprache – Kommunikation – Kultur 4). Frankfurt am Main et al.: Lang.

Neuser, Wolfgang (2000): „Nichtwissen – eine konstitutive Bedingung für den Entwurf von Welt." *Wissensmanagement: zwischen Wissen und Nichtwissen.* Hrsg. Klaus Götz. 2., verb. Aufl. München: Hampp, 85–97.

Oreskes, Naomi/Conway, Erik M. (2010): *Merchants of Doubt. How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming.* London: Bloomsbury Press.

Proctor, Robert N./Schiebinger, Londa (Hrsg.): *Agnotology: The Making and Unmaking of Ignorance.* Stanford: Stanford University Press.

Proctor, Robert N. (2008): "Agnotology. A Missing Term to Describe the Cultural Production of Ignorance (and Its Study)". *Agnotology. The Making and Unmaking of Ignorance.* Hrsg. Robert N. Proctor/Londa Schiebinger. Stanford, Calif.: Stanford Univ. Press. 1–35.

Ravetz, Jerome R. (1993): "The Sin of Science. Ignorance of Ignorance." *Science Communication*, Vol. 15, No. 2, 157–165.

Ravetz, Jerome R. (2006): *Governing the Sciences of the Unknown Unknowns.* Powerpoint-Presentation James Martin Institute, Oxford, 16. Oktober 2006.

Sandig, Barbara (2006): *Textstilistik des Deutschen.* 2., völlig neu bearb. und erw. Aufl. Berlin/New York: de Gruyter.

Stocking, Holly S./Holstein, Lisa W. (1993): "Constructing and Reconstructing Scientific Ignorance: Ignorance Claims in Science and Journalism." *Science Communication*, Vol. 15, No. 2, 186–210.

Stocking, S. Holly (1998): "On Drawing Attention to Ignorance". *Science Communication* 20, 1, 165–78.

Warnke, Ingo H. (2009): „Die sprachliche Konstituierung von geteiltem Wissen in Diskursen." *Wissen durch Sprache. Theorie, Praxis und Erkenntnisinteresse des Forschungsnetzwerkes „Sprache und Wissen".* Hrsg. Ekkehard Felder/Marcus Müller. (Sprache und Wissen 3). Berlin/New York: de Gruyter, 113–140.

Warnke, Ingo H./Spitzmüller, Jürgen (2008): „Methoden und Methodologie der Diskurslinguistik – Grundlagen und Verfahren einer Sprachwissenschaft jenseits textueller Grenzen." *Methoden der Diskurslinguistik. Sprachwissenschaftliche Zugänge zu transtextuellen Ebene.* Hrsg. Ingo H. Warnke/Jürgen Spitzmüller. Berlin/New York: de Gruyter, 3–54.

Wehling, Peter (2003): „Die Schattenseite der Verwissenschaftlichung. Wissenschaftliches Nichtwissen in der Wissensgesellschaft." *Wissenschaft in der Wissensgesellschaft.* Hrsg. Stefan Böschen/Ingo Schulz-Schaeffer. Wiesbaden: VS Verlag, 119–142.

Wehling, Peter (2004): „Weshalb weiß die Wissenschaft nicht, was sie nicht weiß? – Umrisse einer Soziologie des wissenschaftlichen Nichtwissens." Stefan Böschen/Peter Wehling (2004): 35–105.

Wehling, Peter (2006): *Im Schatten des Wissens? Perspektiven der Soziologie des Nichtwissens.* Konstanz: UVK.

Wynne, Brian (2002): "Risk and Environment as Legitimatory Discourse of Technology: Reflexivity Inside Out?". *Current Sociology*, 50; 3; 459–477.

Zehr, Stephen C. (1990): *Acid rain as a social, political and scientific controversy.* Diss., Department of Sociology, Indiana University, Bloomington (IN).

Ziem, Alexander (2009): „Sprachliche Wissenskonstitution aus Sicht der Kognitiven Grammatik und Konstruktionsgrammatik." *Wissen durch Sprache. Theorie, Praxis und Erkenntnisinteresse des Forschungsnetzwerkes „Sprache und Wissen".* Hrsg. Ekkehard Felder/Marcus Müller. (Sprache und Wissen 3). Berlin/New York: de Gruyter, 171–204.

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