

ARTICLES:

Writing about Knowing in Science: Aspects of Hedging French Scientific Writing

Anthony J Liddicoat
Research Centre for Languages
and Cultures Education
School of International Studies
University of South Australia

1. Introduction

Writers of scientific texts use the resources of the language in which they are writing in particular ways to achieve particular purposes related to the discipline in which they are writing (Gross, 1990; Locke, 1992). The language of science is, therefore, more than a set of language choices, it is also a vehicle through which the conceptual system of science is developed and transmitted (Gross, Harmon, & Reidy, 2002). This means that, in developing an understanding of the language of science as communication, it is important to begin to understand how the language choices in scientific writing function in the creation of texts (Liddicoat, 2004). However, the study of French as a language of science has largely been confined to descriptions of the linguistic forms present in scientific writing. Attention has primarily been focused on the lexicons which have been developed for French for Science and Technology (FST), (for example Fossat & Maurand, 1976; Guilbert, 1973; Kočourek, 1982; Phal, 1968; 1969; 1971). Less attention has been paid to the syntax of FST (for example in sections of Kočourek, 1982; Lerat, 1995; Vigner & Martin, 1976). Where sentence grammar has been considered, it is often limited to describing the distributions of features in scientific writing, rather than identifying the function of these syntactic differences. However, there is evidence that the grammatical differences between FST and other forms of French reflect functional differences in the use of language, directly related to the communicative purposes of scientific writing (Gross et al., 2002; Liddicoat, 1992; 1997; Phal, 1968).

One phenomenon which has received a great deal of attention in the study of scientific communication is the role of hedges and the ways in which they shape knowledge claims in science (for example, Crompton, 1997; Huebler, 1983; Hyland, 1994, 1996a, 1996b, 1998; Markkanen & Schröder, 1997; Salager-Meyer,

1994; Skelton, 1988). Much of this research is focused on English with hedging being treated only secondarily in existing studies of French (Gross et al., 2002; Kočourek, 1982). This paper will examine one aspect of the use of hedging in French, the use of modal verbs and some lexical verbs, in research articles in a range of scientific disciplines, in order to develop an understanding of how these verbs are deployed in order to construct representations of knowledge in French scientific texts.

2. Writing about knowing in science

An academic text, like any other written form, involves interaction between the reader and the writer. Widdowson (1984) indicates that academic authors need to consider their audience and anticipate that audience's background knowledge in the subject matter of the paper. They need to consider processing problems the audience might have relating to the text and the possible reactions to the text. Bazerman (1985), studying academic readers, indicates that they are trying to predict the writer's lines of thought, query the writer's position and evaluate the article for its usefulness and importance for their own research work. Effective writing in science and technology cannot, therefore, be only a series of impersonal statements which add up to the truth.

Research articles are rarely simple narratives of investigations. Instead they are complexly distanced reconstructions of research activities, at least part of this reconstructive process deriving from the need to anticipate and discountenance negative reactions to knowledge claims being advanced. (Swales, 1992: 175)

These interactions between writers and readers, the writer's awareness of the reader's evaluation and the desire to convince the reader about his/her work all lead the writer to indicate attitudes about what he is saying. The academic text is structured to accomplish the rhetorical objectives of the writer as has been demonstrated by researchers such as Gilbert and Mulkay (1984) and Latour and Woolgar (1979). As Stubbs (1986: 1) argues 'all sentences encode a point of view'. The sorts of points of view which scientific writers need to encode in presenting their work to the discourse community are very much influenced by understandings of the scientific endeavour. They are influenced most crucially by understandings of the ways in which knowledge can be acquired and the degree to which we can be confident that method will reveal truth.

Hume (1941 [1739]) pointed out that no number of singular observations, however large, could logically entail an unrestrictedly general statement. That is to say that, just because the same events have been observed in the past, there is no guarantee that such events will occur in the future. Popper (1959; 1963; 1974) has pointed out the asymmetry inherent in this position – no number of occurrences of an event proves a universal statement, but one observation contrary to the universal statement disproves it. Thus, it is easy to disprove a general statement, but

impossible to prove it. Popper, however, goes one step further and indicates that even falsification of a theory is difficult.

In point of fact, no conclusive disproof of a theory can ever be produced; for it is always possible to say that the experimental results are not reliable or that the discrepancies which are asserted to exist between experimental results and the theory are only apparent and that they will disappear with the advance of our understanding. (Popper, 1959: 50)

The knowledge claims of scientists, derived from empirical observation, are conjectural knowledge and while this conjectural knowledge may evolve towards more preferable statements of knowledge, it cannot result in ultimate statements of knowledge. As Margenau (1974: 755-756) states: “there is no absolute, ultimate or final truth in science”. For Popper (1963) knowledge then moves from an initial problem through attempted solution to a resulting situation, and from there to new problems. Knowledge, therefore, evolves. It never reaches an ultimate point.

Given that there is no apprehension of ultimate truth, empirical experimental research poses a problem in that it is difficult to establish the ultimate grounds for proposed interpretations of and explanations for observed phenomena, but at the same time the researcher needs to be able to interpret and explain the data and to generalize from experimental observations. The scientist’s awareness that a particular piece of empirical research cannot reveal a totality of knowledge lead to the expression of knowledge gained from such experiments in modest claims.

Myers (1985a; 1985b) maintains that all researchers need to make decisions about the level of the knowledge claims they wish to make. The higher the level of claim, the more likely it is that asserting the claim will contradict existing positions and challenge the assumptions underlying on-going research in the area. Lower level claims may not involve so much risk, but they may also not contribute as much to knowledge in a field. The scientific writer is therefore in a position of tension – the claims s/he makes must be significant enough to be published, but they must follow earlier work in order to be considered appropriate science. As a result, the importance which the scientific discourse community gives to a claim requires that the claim be both original but at the same time closely related to the concerns and methods of current research. Myers indicates that scientists attempt to make the highest level claims they can, frequently modifying the strength of these claims, while basing these claims in the current scientific literature. This is similar to Lyons’ formulation:

we should always make the strongest commitment for which we have epistemic warrant (Lyons, 1977: 799)

The issue, then, for the scientist is the degree of epistemic warrant which can be derived from the results of research and this in turn is linked with understandings of the certainty about knowing which can be derived from empirical enquiry. Writers of research, therefore, modify the epistemic warrant for their knowledge claims.

One way in which the strength of knowledge claims may be modified, but without modifying the content is through “hedges” – linguistic elements “whose job it is to make things fuzzier” (Lakoff, 1972: 195). These devices allow the writer to indicate that s/he is not fully committed to the propositional content of the utterance or is leaving room for modification of the information presented in the statement. Hedging is a valued dimension in the scientific community: “hedging is the mark of a professional scientist, one who acknowledges the care with which he or she does science and writes on science”. (Crismore & Farnsworth, 1990: 135)

However, hedging goes beyond indicating an approach to the task of doing science and indicates a relationship with the discourse community who will read and evaluate the research. The epistemic resources of a language are used by scientific writers to display conventionalised statements about their confidence in their results. These statements are conventionalized in the sense that they are the expectations of the discourse community, rather than the actual representations of the writer’s belief in his/her state of knowledge. That is, hedging appears to be done primarily with the discourse community in mind. This is clearly demonstrated by Knorr-Cetina (1981), who discovered that in the construction of scientific research articles in English the amount of hedging increases in subsequent drafts of the paper and the level of knowledge claims is down-played. That is scientific writers begin with a version of the paper which represents more accurately their own beliefs about the claims they are making and subsequently modify the text to meet the expectations the discourse community has about the sorts of knowledge claims which can be made (Vihla, 1999). The tentativeness which hedging introduces reduces the writer’s accountability for the claims s/he is making by reducing the writers “degree of liability” (Huebler, 1983). Hedges allow the academic writer to anticipate audience reactions by moderating the degree of certainty with which they present their knowledge claims and as such, epistemic modality represents an important means for gaining the discourse community’s acceptance of knowledge claims, and in so doing acts to strengthen scientific argumentation (Meyer, 1997).

Hedging, therefore, reflects the relationship which exists between writers and readers in scientific contexts and goes beyond a simple encoding of the researcher’s certainty about the outcomes of research. This has been demonstrated in both scientific and non-scientific contexts by a number of researchers, including Coates (1987), Holmes (1982; 1984), Myers (1989) and Skelton (1988). In producing scientific writing, researchers present themselves as contributing to the discipline and also as subject to the discipline, cautiously defining their relationship with other researchers within the discourse community. Hedges allow them to produce a closer fit between their statements about new discoveries and the pre-existing understandings within the scientific community (Hyland, 1994). Hedging is, therefore, both cautious and interactive in that they build a relationship between the writer and the community of readers.

3. Method

For this study, ten research articles published in French between 1976 and 1992 were chosen from each of six science disciplines: biology, chemistry, engineering, medicine, physics, and veterinary science. These texts were chosen because they all outlined experimental method and drew conclusions from empirical data. These texts were examined in detail to establish a frequency count of the use of various verb forms. Once these frequency counts were established, the discourse function of the verb forms in the texts was investigated.

4. Modal verbs

4.1. French modal verbs with epistemic modality

French uses three main modal verbs with epistemic functions: *pouvoir* ‘to be able’, *devoir* ‘to be obliged’ and *falloir* ‘to be necessary’, and all three verbs are found in the corpus for this study. These modal verbs are all potentially available with both deontic and epistemic functions and, in order to understand the use of modal verbs in a hedging function, it is important to examine their use in both deontic and epistemic senses FST. The French verb *pouvoir* has both a deontic use— ability or permission – and an epistemic use as is shown by the examples in (1). The epistemic sense of *pouvoir*, as demonstrated by these examples, is that of possibility

- (1) *pouvoir*
Deontic Tu **peux** sortir ce soir, si tu veux. *You may go out this evening, if you want.* (Permission)
Jean **peut** le faire. Je l’ai vu. *Jean can do it. I have seen him.* (Ability)
Epistemic Jean **peut** être à Paris. *Jean may be in Paris.*

Devoir has a deontic meaning of obligation to undertake an action and an epistemic meaning which involves probability.¹

- (2) *devoir*
Deontic Il **doit** me payer l’argent que je lui ai prêté. *He ought to pay me the money. I lent him.* (Obligation)
Epistemic Il **doit** être à Paris ce soir. *He should be in Paris this evening.*

The final verb, *falloir*, is an impersonal verb, which functions slightly differently to the modal auxiliaries *devoir* and *pouvoir*. It is used in three constructions – *falloir* +

¹ Grévisse (1993) in fact focuses on the epistemic uses in his discussion of *devoir*, with these preceding the deontic meanings related to obligation: “Devoir sert à présenter l’action comme vraisemblable, probable, plus ou moins certaine, obligatoire, nécessaire, souhaitable.” *Devoir is used to present an action as realistic, probable, more or less certain, obligatory, necessary, desirable.* (p.748).

infinitive (3a); object pronoun + *falloir* + infinitive (3b); and *falloir que* + subjunctive (3c).

(3a) Il faut partir. *I/you/he/we/they have to leave.*

(3b) Il me faut partir. *I have to leave.*

(3c) Il faut que je parte. *I have to leave.*

The first construction is completely impersonal, with person details only recoverable from context. The other two constructions encode person information, either through the object pronoun or the subject of the subjunctive verb. *Falloir* has a deontic meaning of necessity and an epistemic meaning of probability, however *falloir* provides a stronger epistemic warrant than does *devoir*, although statements made with *falloir* still do not encode full certainty.

(4) *falloir*

Deontic Il vous **faut** revenir à minuit. *You must be back at midnight.* (Necessity)

Epistemic Il **fallait** que le repas lui ait plu. *The meal must have pleased him.*

In the epistemic versions of the sentences shown in (1), (2), and (4), the speaker is expressing information about his/her degree of certainty about the event encoded. The other forms indicate permission, ability, obligation and necessity which are independent of logical underpinnings and degree of certainty. For the writer of science confronted by the need to modify knowledge claims, epistemic modality represents an important resource which can be used to indicate degrees of certainty about knowledge claims. Epistemic modality allows the writer to enter into the text to present his/her views about the level of knowing s/he wishes to present. Lyons (1977) points out that an epistemically unmodified utterance counts as a straightforward statement of fact and that in uttering such a statement, the speaker is committed to the truth of what is uttered. Such an utterance claims to have full epistemic warrant for the proposition. Lyons expresses this as a hierarchy of certainty:

(5) certainty > probability > possibility.

The French modal verbs themselves form a hierarchy similar to this in terms of their epistemic claims, which can be represented as:

(6) certainty > *falloir* > *devoir* > *pouvoir*.

4.2. Modal verbs in FST

The frequency of the verbs *pouvoir*, *devoir* and *falloir* in the corpus is summarized in Table 1. This table shows an overwhelming preponderance of *pouvoir* and a comparative scarcity of *devoir* and especially of *falloir* in the texts studied.

	Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science	Total
pouvoir	98	77	116	57	85	76	509
devoir	16	11	23	20	20	9	99
falloir	3	9	2	6	4	9	33

Table 1: Frequency of modal verbs in FST texts.

4.2.1. Pouvoir

In some cases in scientific writing, *pouvoir* is used in the deontic sense of ability/capacity, which is the basic meaning of the form, especially when *pouvoir* is used in the negative.

- (7) ... le volume que les rayons X **peuvent** traverser ... [E.Che.X] ...*the volume that the X-rays can cross...*
- (8) Les personnes, femmes et hommes, que **nous n'avons** pu étudier, avaient totalement refusé de participer à l'étude... [M.Ed.5:] *The people, men and women, who we could not study, had totally refused to participate.*

In examples such as (7) and (8) above, the verb *pouvoir* is being used the deontic sense of 'ability/capacity' and does not constitute a hedge to knowledge claims. A related use is found in examples (9) and (10).

- (9) Trois examens **peuvent** être actuellement utilisés. *Three examinations can be used at the moment.* [B.Xx.X]
- (10) Ces combustibles **peuvent** être stocké pendant des périodes pratiquement illimitées...[C.Ak.614] *These combustibles can be stockpiled for practically unlimited periods.*

In these examples, *pouvoir* is not used as a verb denoting ability, but in an equally deontic sense denoting potentiality – the availability of resources through which an action can be undertaken. In spite of these deontic uses, however, in the majority of cases, *pouvoir* is used in an epistemic sense (see Table 2).

	Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science	Total
Ability	26	20	17	8	9	12	92
Potential	17	13	33	5	20	14	102
Epistemic	55	44	66	44	56	50	315
Total	98	77	116	57	85	76	509

Table 2: The proportion of possible uses of *pouvoir* in FST

As an epistemic modal the verb *pouvoir* is frequently used with formulations in which the outcomes of a particular procedure are evaluated or the understanding derived from the experiment is formulated.

- (11) La faiblesse musculaire très fréquente dans la maladie de Friedrich **peut facilement** être reliée à un déficit énergétique, surtout dans les conditions de travail, ou de surcharge métabolique. [M.Ed.X] *The very frequent muscular weakness in Friedrich's disease can easily be linked to an energy deficit, especially in work situations, or a metabolic overload.*
- (12) Les écaillages **peuvent** être la cause de la diminution des quantités détectées des phases d'oxydes (Cr₂O₃ et NiCr₂O₄) lorsque les temps d'oxydation est long. [E.Xx.X] *The scaling may be the cause of the decrease in the detected quantities of oxide phases (Cr₂O₃ and NiCr₂O₄) when the time of oxidation is long.*

This construction appears to emphasize the potential the data offers for the formulation to be made, and draws on the deontic meaning the verb *pouvoir* in its sense of ability/permission in order to do so. In this sense, the conclusions drawn by the researchers are expressed as being 'permitted' by the data, rather than expressed as the conclusion of the researchers themselves. Epistemic *pouvoir* is often combined with passive constructions as is the case for example (10) in the main verb of the sentence, which further reduces the agency of the researchers in forming the conclusions. In such constructions, the verb *pouvoir* allows the scientist to be distanced from the conclusion or observation – the role of human intervention in the understanding of scientific work is thereby minimized, and higher level knowledge claims, involving interpretation and deduction, are presented as an objectively, data-driven understanding of phenomena.

Where additional tentativeness is required for an assessment, *pouvoir* may be used in the conditional tense, as in (13).

- (13) Cela **pourrait** être dû à l'enfouissement de la représentation du pied dans le sillon inter-hémisphérique ou des variations individuelles de la topographie crânio-encéphalique... [M.Ed.X] *This could be due to the burial of the representation of the foot in inter-hemispheric sulcus or individual variations in the cranio-encephalic topography.*

The use of the conditional incorporates the 'permitted' nature of the conclusion drawn from the verb *pouvoir* together with the dubitative force of the conditional (for the function of the conditional see Liddicoat, 1997): this has the function of constructing new knowledge as required by the data, but with a greater possibility of error than would be the case with indicative verb forms.

In these epistemic uses, *pouvoir* is used for what Lyons (1977) calls subjective epistemic possibility. The verb is used to construct a conclusion or interpretation as

being allowed by the data and in so doing presents it as proceeding from the known (that is the experimental observation) but with the possibility of error in understanding the data. The core function of *pouvoir* in scientific discourse then can be summarised as (14):

(14) *Pouvoir*: In the light of what is known, it is possibly the case that X

Pouvoir, therefore, represents as low level of certainty about the reported formulation as, as such, is a relatively weak knowledge claim.

4.2.2. Devoir

Both epistemic and deontic uses of *devoir* are found in scientific writing, although there appears to be a difference in the frequency of the uses of the two modes in different disciplines (see Table 3)

	Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science	Total
Obligation	5	3	6	10	2	1	27
Epistemic	11	8	17	10	18	8	72
Total	16	11	23	20	20	9	99

Table 3: The proportion of possible uses of *devoir* in FST

In its deontic sense of obligation, *devoir* is used either to indicate some responsibility on the part of the researchers or some requirement of the situation which the researchers need to respond to in order for the research to be effective of successful.

(15) Nous **devons** signaler que les résultats que nous venons de présenter sur la réactivité des α -alcoylaminonitriles et CO₂ ne sont pas en contradiction avec ceux de Trigo et coll. [C.Ro.X] *We should indicate that the results on the radioactivity of α -alcoylaminonitrils and CO₂ that we have just presented are not contradictory to those of Trigo et al.*

(16) La récupération a été accélérée par des inhalations de salbutamol qui **ont dû** parfois être répétées et abondantes. [M.Ed.X] *Recuperation was accelerated by inhalations of salbutamol which had sometimes to be repeated and numerous.*

(17) La destruction de ce film formé d'alumine plus ou moins hydraté **doit** être évitée absolument. [E.Xx.X] *The destruction of this film formed of more or less hydrated aluminium should be absolutely avoided.*

This deontic use is found in all disciplines, but it is more frequent in medical writing, and this seems to be related to the content of the medical writing in which intervention is much more important than in other disciplines. The researchers, as

in example (16), are more often required to modify their activities because situations occur which affect patient survival.

Used epistemically, *devoir* encodes epistemic necessity (Lyons, 1977) and is used to express a likely hypothesis or conclusion.

- (18) Du fait de la régularité de la dipyramide, l'angle du triangle en S vaudrait 72° et la base B la base B **devrait** alors représenter 1,18 fois A. [C.Cc.X] *Given the regularity of the dipyramid, the angle of the triangle S would be 72° and the base B should then represent 1.18 times A.*
- (19) Ainsi si l'on admet que l'ionisation Penning par le métastable dans l'état 21S est un processus d'ionisation directe, la distribution angulaire des électrons éjectés qui en résulte **doit** être quasiment identique à celle résultant du processus de photoionisation par les photons correspondant à la transition 21P-IIS [C.Tu.X] *Thus if one allows that the Penning ionisation be the metastable in the 21S state is a process of direct ionisation, the angular distribution of the ejected electrons which results should be almost identical to that resulting from the process of photoionisation by photons corresponding to the transition 21P-IIS*

As in examples (18) and (19), the verb *devoir* typically co-occurs with a statement of outcome or result and indicates that the result is in a sense forced by what is currently known about the phenomenon under investigation. In this case, too, the deontic force of necessity seems to influence the interpretation of the epistemic modal, which indicates that the conclusion drawn is required by the data. The core function of *devoir* in scientific discourse then can be summarised as (14):

- (20) *Devoir*: In the light of current knowledge, it is necessarily the case that X.

Devoir, therefore, encodes a stronger knowledge claim than *pouvoir* and can be considered a modal of probability rather than possibility.

4.2.3. Falloir

Falloir is found in the corpus only in the impersonal construction and in the subjunctive construction: no examples of the 'object pronoun *falloir* + infinitive' construction were found. The most common construction, however, is by far the impersonal *il faut*, although overall *falloir* is infrequent in the corpus (see Table 1). *Falloir* is used in its deontic sense on necessity, as in (21).

- (21) A fin de préciser la structure magnétique il **faut** normer les intensités. [C.Cc.X] *In order to specify the magnetic structure, one has to standardize the intensities.*

Here it represents a requirement imposed on the researchers which must be met in order to carry out the experiment. In these cases, the researchers do not have

discretion over the event, but rather the event is mandatory for the successful or adequate completion of the experiment. In addition to these uses, *falloir* is found with a verb of reporting, such as *noter* ‘to note’, *préciser* ‘to specify or *souligner* ‘to underline, to emphasise’, as in examples (22) and (23).

(22) il **faut** cependant souligner que la durée des essais était insuffisante. [C.Cc.C]
One must, however, emphasize that the duration of the tests was insufficient.

(23) il **faut** cependant noter la présence systématique d’un pic vers 12% de taux d’humidité [E.Ee.E] *One must, however, note the systematic presence of a peak about 12% in the humidity rate.*

In this case, the researcher seems to be expressing some obligation on his/her part to draw information to the attention of the reader which has an impact on how the experiment will be viewed, or to call the readers attention to an important fact about the experimental situation. In this way, *falloir* plays a directive function in the construction of the text, in that it directs the attention of the reader to important points which the writer wishes to highlight. This use is the most commonly found for the very limited number of instances of *falloir* (see Table 4).

	Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science	Total
Necessity	1	3	1	3	2	1	11
Directive	2	6	1	3	2	8	22
Total	3	9	2	6	4	9	33

Table 4: The proportion of possible uses of *falloir* in FST

There were no instances of epistemic uses of *falloir* in the corpus. This may be because *falloir* represents a very strong knowledge claim, although with less certainty than would have been shown by an utterance with no epistemic modification. It may be that this construction is felt to represent too strong a knowledge claim within scientific discourse communities. Epistemic necessity in the texts studied is encoded by the weaker formulation *devoir*, rather than by *falloir*.

5. Other verbs

5.1. Sembler

The verb *sembler* ‘to seem’ is used in two constructions in French – *sembler* + adjective and *sembler* + clause, both of these constructions are found in the data (see Table 5). In the former construction, *sembler* is functioning as a modified copula, as in:

(24) Il **semble** souhaitable *It seems desirable.*

The *sembler* + clause construction can have two forms – an infinitival clause or a tensed clause introduced by *que*:

(25a) Les résultats **semblent** confirmer l’hypothèse *The results seem to confirm the hypothesis.*

(25b) Il **semble** que les résultats confirment l’hypothèse. *It seems that the results confirm the hypothesis.*

Both of these clausal constructions are found in the scientific texts studied (see Table 5), however, the tensed construction is relatively rare and the two clausal constructions have been treated together in the discussion below given the small number of the tensed constructions.

	Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science	Total
+ clause	9	7	12	4	4	7	43
Copula	6	1	2	6	6	8	29
Total	15	8	14	10	10	15	72

Table 5: The proportion of possible uses of *sembler* in FST

Unlike the modal verbs examined above, *sembler* does not express epistemic as opposed to deontic modality. Instead *sembler*, regardless of the construction, seems to encode a judgement or conclusion made by the writer and at the same time expresses reservations about that judgement. *Ssembler* expresses the idea of the judgement of conclusion having the appearance of being correct and as such, it represents a very weak knowledge claim.

(26) Dans les phases M₃YX₃ déjà connues, la nature de l’élément métallique semble jouer un rôle structural déterminant. [C.RH.X] *In the already known M₃YX₃ phases, the nature of the metallic element seems to play a determining structural role.*

(27) Deux études récentes semblent confirmer cet effet favorable des alkylants. [M.Bl.a] *Two recent studies seem to confirm this favorable effect of alkalines.*

(28) L’accroissement de l’excrétion urinaire du phosphate semble indépendant de l’action de la PTH. [M.Ed.X] *The growth of urinary excretion of phosphate seems independent of the action of the PTH.*

Ssembler is used when the researcher, having made a judgement about the material, wishes to indicate that s/he not entirely certain that the statement s/he is making is correct. The verb *sembler* can be used to indicate that the grounds for the judgement may be incomplete – that the necessary evidence may be inadequate, but does nonetheless suggest that the judgement made could be valid. It indicates that the writer has inferred the judgement on the basis of the evidence available.

5.2. Apparaître and paraître

The verbs *apparaître* and *paraître* (both meaning ‘to appear’) have two basic senses in the corpus. The basic meaning is that something becomes visible or apparent. This usage is particularly common in chemistry texts.

(29) Ces données font nettement **apparaître** les faits suivants: [C.Ak.i] *These data clearly reveal the following facts:*

The sense of becoming apparent can be considered to be the basic meaning of the verb, however, in a more metaphorical sense, *apparaître* and *paraître*, also have a hedging function similar to that of *sembler*. Like *sembler*, these verbs indicate that the judgement made by the researchers is tentative, but possible based on the evidence available. These verbs are found as both as a hedged version of a copula and as a verb introducing a clausal component. Also like *sembler*, these verbs can potentially be found in impersonal constructions of the type *il apparaît que ...* and *il paraît que ...*, these forms are found in the corpus, but are quite rare. In all cases, the verbs *apparaître* and *paraître* are used with referential NPs or anaphoric pronouns. The distribution of *apparaître* and *paraître* is presented in Table 6.

	Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science	Total
primary meaning							
<i>apparaître</i>	8	14	10	1	10	6	49
<i>paraître</i>	0	0	2	2	1	0	5
Total	8	14	12	3	11	6	54
With clause							
<i>apparaître</i>	5	4	1	0	0	0	10
<i>paraître</i>	1	0	1	0	0	0	2
Total	6	4	2	0	0	0	12
as copula							
<i>apparaître</i>	2	5	1	4	0	2	14
<i>paraître</i>	4	0	2	2	0	0	8
Total	6	5	3	6	0	2	22

Table 6: The proportion of possible uses of *apparaître* and *paraître* in FST

This table shows that the incidence of both verbs is very small, with *paraître* being much less used than *apparaître*. In some disciplines the clausal use was entirely absent while in the physics texts neither verb was used with any hedging function. These two verbs were rarely used as a hedge more than once per article and never more than twice per article, indicating that these verbs have a very reduced function as hedging devices in scientific writing. In fact, a large proportion of the texts did not use *apparaître* or *paraître* at all as a hedge. Where it is used as a hedge, it is usually used to introduce a conclusion of interpretation:

- (30) Il **apparaît** aussi qu'il n'y a pas de place dans ces «canaux» pour la troisième molécule d'eau. [C.Me.r] *It also appears that in these "channels" there is no more room for the third molecule of water.*
- (31) L'ion Rb^+ **apparaît** pourtant mieux centré par rapport à son environnement d'atomes d'oxygène que l'ion Cs^+ . [C.LL.a] *The ion Rb^+ appears however better centred in relation to its environment of oxygen atoms than the ion Cs^+ .*

The main difference between *sembler* and the verbs *apparaître* and *paraître* is that *apparaître* and *paraître* emphasize that the visible or perceptible nature of the evidence for a judgement. That is, rather than simply indicating that the researcher has inferred the judgement from the evidence, *apparaître* and *paraître* indicate that the researcher has perceived events, actions or results which have lead him/her to infer the proposition contained in the statement. The knowledge claim made here is therefore linked to an experience of phenomena and so it would appear that the claim is stronger than that made by *sembler*, which encodes the conclusions of a more abstract thought process.

5.3. Tendre

The verb *tendre* 'to tend' is used to indicate that a process is a tendency rather than a certainty. The verb *tendre* is, however, quite rare in the corpus (seen Table 7) and, in fact, is never found more than once in any of the texts studied.

Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science	Total
0	2	2	1	0	0	5

Table 7: The number of uses of *tendre* in FST

Tendre marks that an observation or event is described in an approximative way, and should not therefore be expected as a regular occurrence.

- (32) L'assemblage tend à ressembler à celui des bronzes cubiques [C.La.m] *The assembly tends to resemble that of the cubed bronzes.*
- (33) Ce taux décroît rapidement dans les 4 millimètres qui suivent et tend vers 0 dans le milieu de l'entre-noeud. [E.Be.n] *This ratio decreases rapidly in the 4 millimetres that follow and tends towards 0 in the environment of the internode.*

The verb seems to encode an extremely weak knowledge claim in these uses.

6. The distribution of hedges in the texts

Hedging verbs are not evenly distributed across all on the rhetorical divisions of the texts studied. The distribution of hedging markers is summarized in Table 8.

Table 9 shows the proportion of articles making knowledge claims with each of the verbs.

	Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science
<i>Falloir</i>	0	0	0	0	0	0
<i>Devoir</i>	70	50	70	40	80	80
<i>Pouvoir</i>	100	100	100	100	100	100
<i>Sembler</i>	60	60	50	60	40	100
<i>apparaître/paraître</i>	50	60	60	40	0	20

Table 9: Percentage of articles making knowledge claims with hedging verbs

The verb *pouvoir* is used to make knowledge claims in all articles in all disciplines, with *devoir* being the next most common form in most disciplines, although less used in medicine and chemistry articles. *Sembler* is also highly used, and occurs in all of the veterinary science papers. A similar pattern can be seen in Table 10, which shows the proportion of edges according to type in each of the disciplines.

	Biology	Chemistry	Engineering	Medicine	Physics	Veterinary Science
<i>tendre</i>	0.0	2.2	2.2	1.1	0.0	0.0
<i>pouvoir</i>	59.1	62.0	63.5	62.0	66.7	66.7
<i>sembler</i>	16.1	11.3	13.5	14.1	11.9	20.0
<i>apparaître/paraître</i>	12.9	12.7	4.8	8.5	0.0	2.7
<i>devoir</i>	11.8	11.3	16.3	14.1	21.4	10.7
<i>falloir</i>	0.0	0.0	0.0	0.0	0.0	0.0

Table 10: Proportions of verbs used for hedging by discipline (%)

This table shows that *pouvoir* is by far the most common hedging verb in the corpus for each discipline, with *sembler* being the next most common in most disciplines, followed by *devoir* and *apparaître/paraître*. This distribution indicates a preference in the text for using middle level verbs, especially *pouvoir*, for encoding knowledge claims, with less use of both higher and lower level knowledge claims, and no use of the highest unmodified epistemic warrant *falloir*. Verb use seems to correlate with claims made that scientists need to find a balance between the originality and significance of their results and their continuity with previous scientific thinking (Myers, 1985b; Vihla, 1999). Low level verbs like *sembler*, *apparaître* and especially *tendre* have the potential to compromise the perception of the significance of the findings by making them sound too tentative. High level verbs like *falloir* and *devoir*, although making the significance of the findings clearer, run the risk of appearing to contradict existing positions and overstate certainty.

The study of modal and lexical verbs used for hedging in French reveals not only the resources which academic writers may deploy in constructing their texts, but also how they approach the issue of knowing and representing knowing in the articulation of science. The use of hedges, and their distribution in the texts, reveals

that, in working from observation to interpretation, scientists are producing statements about knowledge which are conjectural rather than ultimate statements of knowledge. The language encoding the text embeds the possibility that a series of observations does not guarantee that the events observed will always occur in the future or that the interpretation of those events may differ in the light of as yet unknown factors. Science is constructed through possible knowledge rather than assured knowledge and moderate knowledge claims are preferred to strong knowledge claims. Hedging allows the scientist to express scientific claims with a degree of caution (Hyland, 1995) and in so doing, constructs science as a cautious empirical search for truth. In disposing of the resources provided by the French language, scientists can be seen to construct a particular approach to the resources which exist in the language in order to encode science. Most notably, they appear to avoid one of the resources offered by French, the verb *falloir*, which has a high degree of epistemic certainty. By avoiding this verb, and encoding epistemic necessity only with *devoir*, they construct a world of knowledge in which interpretations are permitted or obliged by the data, but are never totally imperative.

8. References

- Bazerman, C. (1985). Physicists reading physics: Schema-laden purposes and purpose-laden schema. *Written Communication*, 2(1), 3-23.
- Coates, J. (1987). Epistemic modality and spoken discourse. *Transactions of the Philological Society*, 85, 100-131.
- Crismore, A., & Farnsworth, R. (1990). Metadiscourse in popular and professional science discourse. In W. Nash (Ed.), *The Writing Scholar: Studies in Academic Discourse* (pp. 119-136). Newbury Park, CA: Stage.
- Crompton, P. (1997). Hedging in academic writing: some theoretical problems. *English for Specific Purposes*, 16(4), 271-287.
- Fossat, J.-L., & Maurand, G. (1976). *Les lexiques techniques français*. Toulouse : University of Toulouse.
- Gilbert, G. N., & Mulkay, M. (1984). *Opening Pandora's Box : A Sociological Analysis of Scientific Discourse*. Cambridge: Cambridge University Press.
- Grévisse, M. (1993). *Le bon usage* (13th ed.). Paris: Duculot.
- Gross, A. G. (1990). *The rhetoric of science*. Cambridge, MA: Harvard University Press.
- Gross, A. G., Harmon, J.R., & Reidy, M. (2002). *Communicating science: The scientific article from the 17th century to the present*. Oxford University Press.
- Guilbert, L. (1973). La spécificité du terme scientifique et technique. *Français moderne*, 17, 5-17.
- Holmes, J. (1982). Expressing doubt and certainty in English. *RELC Journal*, 13, 19-28.
- Holmes, J. (1984). Modifying illocutionary force. *Journal of Pragmatics*, 8, 345-365.
- Huebler, A. (1983). *Understatements and Hedges in English*. Amsterdam: John Benjamins.

- Hume, D. (1941 [1739]). *Treatise on Human Nature* (L.A. Selby-Bigge ed.). London: Oxford University Press.
- Hyland, K. (1994). Hedging in academic writing and EAP textbooks. *English for Specific Purposes*, 13 (3), 239-256.
- Hyland, K. (1995). The author in the text: Hedging in scientific writing. *Hong Kong Papers in Linguistics and Language Teaching*, 18, 33-42.
- Hyland, K. (1996a). Talking to the academy: forms of hedging in science research articles. *Written Communication*, 13 (2), 251-281.
- Hyland, K. (1996b). Writing without conviction: Hedging in science research articles. *Applied Linguistics*, 17 (4), 433-454.
- Hyland, K. (1998). *Hedging in Scientific Research Articles*. Amsterdam: John Benjamins.
- Knorr-Cetina, K. D. (1981). *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science*. Oxford : Pergamon Press.
- Kočourek, R. (1982). *La langue française de la technique et de la science*. Wiesbaden: Brandstetter.
- Lakoff, G. (1972). Hedges: A study in meaning criteria and the logic of fuzzy concepts. *Chicago Linguistic Society Papers*, 8 (183-228).
- Latour, B., & Woolgar, S. (1979). *Laboratory Life: The Social Construction of Scientific Facts*. Beverly Hills, CA : Sage.
- Lerat, P. (1995). *Les langues spécialisées*. Paris : Presses Universitaires de la France.
- Liddicoat, A. J. (1992). The use of the active and passive in French scientific prose : Some examples from the biological sciences. *Rassegna italiana di linguistica applicata*, 14 (2), 105-121.
- Liddicoat, A. J. (1997). The function of the conditional in French scientific writing. *Linguistics*, 35, 767-780.
- Liddicoat, A. J. (2004). Grammar as a feature of text construction: Tense, time and rhetorical function in French journal articles in biology. *Written Communication*, 21 (4), 316-343.
- Locke, D. (1992). *Science as writing*. New Haven, Ct: Yale University Press.
- Lyons, J. (1977). *Semantics*. Cambridge: Cambridge University Press.
- Margenau, H. (1974). On Popper's philosophy of science. In P. A. Schilpp (Ed.), *The Philosophy of Karl Popper* (pp. 961-1197). La Salle, Ill: Open Court.
- Markkabebe, R., & Schröder, H. (Eds.). (1997). *Hedging and Discourse: Approaches to the Analysis of a Pragmatic Phenomenon in Academic Texts*. Berlin and New York: Walter de Gruyter.
- Meyer, P. G. (1997). Hedging strategies in written academic discourse: Strengthening the argument by weakening the claim. In R. Markkanen & H. Schröder (Eds.), *Hedging and Discourse: Approaches to the Analysis of Pragmatic Phenomena in Academic Texts* (pp. 21-41). Berlin: Walter de Gruyter.
- Myers, G. (1985a). The social construction of two biologists' proposals. *Written Communication*, 2 (3), 219-245.
- Myers, G. (1985b). Text as knowledge claims: The social construction of two biology articles. *Social Studies of Science*, 15 (4), 593-560.

- Myers, G. (1989). The pragmatics of politeness in scientific articles. *Applied Linguistics*, 10 (1).
- Phal, A. (1968). De la langue quotidienne à la langue des sciences et des techniques. *Le Français dans le monde*, 61, 12-19.
- Phal, A. (1969). La recherche en lexicologie au CREDIF : La part du lexique commun dans les vocabulaires scientifique et technique. *Langue française*, 2, 73-81.
- Phal, A. (1971). *Vocabulaire général d'orientation scientifique*. Paris : Didier.
- Popper, K. R. (1959). *The Logic of Scientific Discovery*. London: Hutchinson.
- Popper, K.R. (1963). *Conjectures and Refutations: The Growth of Scientific Knowledge*. London: Hutchinson.
- Popper, K. R. (1974). Replies to my critics. In P. A. Schilpp (Ed.), *The Philosophy of Karl Popper* (pp. 961-1197). La Salle, Ill: Open Court.
- Salager-Meyer, F. (1994). Hedges and textual communicative function in medical English. *English for Specific Purposes*, 13 (2), 149-170.
- Skelton, J. (1988). The care and maintenance of hedges. *ELT Journal*, 4 (1), 37-43.
- Stubbs, M. (1986). A matter of prolonged fieldwork: *Notes towards a modal grammar of English*. *Applied Linguistics*, 7 (1), 1-25.
- Swales, J. (1992). *Genre Analysis: English in academic and research settings*. Cambridge : Cambridge University Press.
- Vigner, G., & Martin, A. (1976). *Le français technique*. Paris : Didier.
- Vihla, M. (1999). *Medical Writing : Modality in Focus*. Amsterdam: Rodopi.
- Widdowson, H. G. (1984). *Explorations in Applied Linguistics (Vol. 2)*. Oxford: Oxford University Press.

ABSTRACT

Writing about Knowing in Science: Aspects of Hedging French Scientific Writing

Anthony J Liddicoat
Research Centre for Languages
and Cultures Education
School of International Studies
University of South Australia

This paper examines a corpus of French research articles across a number of disciplines in order to examine the ways in which writers use modal verbs *pouvoir*, *devoir* and *falloir* and the lexical verbs *sembler*, *paraître*, *apparaître* and *tendre* to determine elements of their meaning and how writers use these to encode knowledge claims in their texts. The study reveals that scientific writers chose middle levels of epistemic warrant to represent their knowledge claims and in so doing construct science as a field of endeavour in which interpretations are potentially falsifiable.
