HOW MODALITY MAY FUNCTION IN SOME EARLY ISSUES OF THE PHILOSOPHICAL TRANSACTIONS

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Abstract: *The Philosophical Transactions was founded by Henry Oldenburg in 1665. The contents of the journal were based on his correspondence, and initially consisted of extracts from the many letters he received. The scope of the journal was that of "natural philosophy", or science and technology in contemporary terms. The linguistic features of its early issues are of particular interest. Among these is that of modality. A previous study indicated that the most common form used to express modality is that of the modal auxiliaries, and the most frequent auxiliaries are may and will. The type of modality that is most commonly expressed is dynamic. Study of an enlarged sample confirms the dominance of auxiliaries but the specific auxiliaries used vary from issue to issue. It also confirms the dominance of dynamic modality. This is consistent with the focus on physical observation and experiment which was adopted by the Royal Society.*

Key words: *modal auxiliaries, modality (epistemic, dynamic, deontic), Philosophical Transactions, scientific text, seventeenth century.*

1. INTRODUCTION

The study presented here considers one facet of texts in early issues of the *Philosophical Transactions*. Since these texts may be considered to be the beginnings of the scientific research article, they have implications for the study of this genre as it has developed up to the present day. In this article[1] I shall first give a little historical background. I shall then give, fairly briefly, the results of a previous study of modality in an early issue of the *Philosophical Transactions* (Banks forthcoming). Since this was carried out on a small sample, the main part of the article will be devoted to an analysis of a further small sample, whose modest objective is to see to what extent it corroborates or contradicts the results of the first study. Both of these fit into my current research programme which includes Banks 2008, 2009a, b, c, 2010a, b.

2. BACKGROUND

The *Philosophical Transactions* was founded by Henry Oldenburg in 1665. Although it had the imprimatur of the Royal Society, since they had given the order for it to be produced (Lyons 1944, Gribbin 2005), it remained the personal property of Oldenburg, whose idea it had been in the first place. Unlike most other scientists of his day, Oldenburg was not a *virtuoso*, that is, he did not have a private income, and the *Philosophical Transactions* was conceived of as a means of augmenting his earnings. He had become the centre of a network of scientific correspondence, and his intention was to provide a journal of scientific news based on the letters he received (Bluhm 1960, Avramov 1999, Hall 2002). Such networks of correspondence were not uncommon, and the letters involved were not strictly private. It was understood that they should be copied, sent on, read at meetings, and so on. Thus, letters were seen as a means of dissemination of new knowledge, and they could even be cited in priority disputes (Gotti 2006). The first issue of

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the *Philosophical Transactions* appeared on 3 March, only two months after the first issue of the *Journal des Sçavans* in Paris, which thus has the distinction of being the first academic journal (Cocheris 1860, Paris 1903, Morgan 1928). Interestingly, both of these journals still exist today. Since the *Philosophical Transactions* has, over the centuries, acquired a reputation as a major scientific publication, the linguistic features of its early issues are of particular interest, as they can be seen as the seeds from which the modern scientific research article evolved.

3. THE PHILOSOPHICAL TRANSACTIONS, 3 JULY 1665

In a previous study, I considered the incidence of modality in the issue of the *Philosophical Transactions* for 3 July 1665. This contains six items. As far as possible typological features such as italics have been preserved; "long-s" has however been replaced by a contemporary "s".

An Account, how Adits & Mines *are wrought at* Liege *without* Air-shafts, communicated *by Sir* Robert Moray.

This first item is a description of ventilation systems in mines near Liège.

A way to break easily *and* speedily *the hardest* Rocks, *communicated by the same Person, as he received it from Monsieur* Du Son, *the Inventor*.

This is a description of a tool for breaking rocks

Observables upon a Monstrous Head.

This is a report of the dissection of the head of a deformed foal.

Observables in the body of the Earl *of* Balcarres.

This is an autopsy report.

Of the designed Progress to be made in the Breeding of Silkworms, *and the* Making *of* Silk, *in* France.

This is a book review of a book written in French on the French silk industry

Enquiries concerning Agriculture.

The final item is a questionnaire on farming methods in England.

The modal expressions found in this issue are shown in Table 1[2]. In the tables individual items are identified by the first words of their headings.

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[2] Percentages in Tables are rounded to the nearest integer. Any discrepancies are due to rounding.

Table 1. Forms of modal expressions in Philosophical Transactions 3 July.

	Aux	Vb	Adj	Adv	Comb	Total
An account	15	5	2	-	2	24
A way to	22	16	2	-	-	40
Observables upon	3	3	-	1	-	7
Of the designed	17	5	2	1	1	26
Enquiries	8	-	-	-	-	8
Total	65	29	6	2	3	105
	62%	28%	6%	2%	3%	

There are no modal expressions in the autopsy of the Earl of Balcarres, which is consequently omitted from the table. The auxiliaries found are *may*, *can*, *could*, *will*, *would*, *shall*, *should*, and *must*. There are no examples of *might* in this sample. The other verbal forms (Vb) found are *be* followed by the infinitive, the modal lexical verbs *seem* and *require*, and the semi-modal *need*. It can be seen that auxiliaries account for 62% of the modal expressions, and other verbal forms for 28%; the other forms are relatively rare. These are adjectival forms, adverbial forms, and combinations of other forms.

The distribution of the modal auxiliaries is given in Table 2.

Table 2. Modal auxiliaries in Philosophical Transactions 3 July.

	may	can	could	will	would	shall	should	must	total
An account	6	2	-	5	-	-	-	2	15
A way to	9	2	-	6	-	1	-	4	22
Observables upon	1	-	1	-	-	-	1	-	3
Of the designed	6	-	-	5	-	-	2	4	17
Enquiries	3	-	-	3	1	1	-	-	8
Total	25	4	1	19	1	2	3	10	65
	38%	6%	2%	29%	2%	3%	5%	15%	

It can be seen that the most frequently used modal auxiliary is *may*, which accounts for 38% of the auxiliaries; the auxiliary *will* accounts for a further 29%, and *must* 15%. The others are relatively marginal.

A simple, and fairly traditional, breakdown of the semantic functions of modality has been adopted (Palmer 1986, Perkins 1983, Larreya 1984). These can be seen in terms of epistemic modality, which deals with judgments of human knowledge in terms of the possibility, probability or certainty of a proposition being true; and root modality which can be further divided into dynamic modality which operates on a physical plane, such as physical possibility or capacity, and deontic modality which operates on a moral plane, thus involving obligation and permission. The distribution of these functions is given in Table 3.

Table 3. Semantic functions of modals in Philosophical Transactions July 3.

	No	%
epistemic	9	9
dynamic	92	88
deontic	4	4

Here it can be seen that the vast majority (88%) of modal expressions are dynamic, such as[3]:

1. Into this hole there is fixed a square *Tube* or *Pipe* of Wood, whereof the Joints and Chinks are so stopt with Parchment pasted or glewed upon them that the Air **can** no where get in to the Pipe but at the end:

2. This *Wedge* **must** have an Hole drilled through the longest side of it, to be filled with *priming Powder*, for firing of the Powder in the *Cartridge*, which **needs** have no more, than half a pound of Powder …

Only a small percentage (9%) are epistemic, of which the following provides examples:

3. … but to some it **seemed** to be a production of the matter designed for the Nose, but diverted by this Monstrous Conception: **perhaps** the *Processus Mammillares* joined into one, and covered with a thin hairy skin.

And the four (4%) examples of deontic modality which occur do so in the same item, that on the silk industry in France. The following provides an example:

4. The present *French King*, hath lately revived and seconded that Undertaking by giving express order that it **should** be promoted by all possible means …

The *Philosophical Transactions*, 5 June 1665

The issue for 3 July ends with the following rather ominous statement:

Advertisement
The Reader *is hereby advertised that by reason of the present Contagion in* London, *which may unhappily cause an interruption as wel of* Correspondencies, *as of* Publick Meetings, *the Printing of these* Philosophical Transactions *may possibly for a while be intermitted; though endeavours shall be used to continue them, if it may be*.

The *contagion* in question was the plague, and this caused an interruption in the production of the *Philosophical Transactions*. However, after what was, in the circumstances, a surprisingly short break the *Philosophical Transactions* reappeared in November. Nevertheless, because of this, it has been decided to consider the previous issue, that for 5 June, rather than the following issue which appeared five months later.

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[3]   In examples, the relevant item has been highlighted in bold. Otherwise, spelling, capitals, italics, etc. are as in the original, with the exception of "long-s" which has been replaced by a modern "s".

The *Philosophical Transactions* for 5 June has nine items:

A Relation of some extraordinary Tydes in the West-Isles of Scotland, *as it was communicated by Sr.* Robert Moray.

The first item here is a description of tidal movements, two pages long.

Monsieur Auzout's *Judgment touching the APertures of* Object-Glasses, *and their* Proportions, *in respect of the several* Lengths *of* Telescopes.

This is a presentation of a Table of apertures and lengths of telescopes taken from a tract or treatise by the French scientist Adrien Auzout. This is a little more than one page.

Considerations of Monsieur Auzout *upon Mr.* Hook'*s New Instrument for Grinding of* Optick-Glasses.

This is an extract from the same work which criticizes Hooke's instrument for grinding lenses, which had been described in his book, *Micrographia*. This is the longest item in the issue at seven pages long.

Mr. Hook'*s Answer to Monsieur* Auzout'*s Considerations, in a letter to the Publisher of these* Transactions.

This item is Hooke's answer to Auzout's criticism, in the form of a letter to the editor, five and a half pages long.

Of a means to illuminate an Object in what pro-Portion one pleaseth; and of the Distances requisite to burn Bodies by the Sun.

This is a further extract from Auzout's treatise about the use of lenses, just over a page long.

A further Account, touching Signor Campani'*s* Book *and Performances about* Optick-glasses.

This item is another extract from Auzout's book; this is a criticism of a book by Campani, on telescopes, four pages long.

Signor Campani's *Answer: and Monsieur* Auzout'*s Animadversions thereon*.

This item gives Campani's answer, and Auzout's response to it, again taken from Auzout's book, and two pages long

An Account of Mr. Richard Lower'*s newly published* Vindication *of Doctor* Willis'*s* Diatribia *de* Febribus.

This is a short review of a medical book by Richard Lower, one page long.

A Note touching a Relation, inserted in the last Transactions.

The final item in this issue is a corrigendum note of six lines.

This issue is then built around the book by Auzout. Six of the nine items relate to it.

4. MODAL EXPRESSIONS

Table 4 gives the distribution of modal expressions in the 5 June issue of the *Philosophical Transactions*.

Table 4. Forms of modal expressions in Philosophical Transactions 5 June.

	Aux	Vb	Adj	Adv	Nom	GM	Comb	total
A relation	2	-	-	-	1	-	1	4
Monsieur Auzout's	3		-	-	-	-	-	3
Consideration	79	10	10	-	-	-	1	100
Mr Hook's	58	11	6	5	1	8	2	91
Of a means	7	2	2	-	-	-	1	12
A further account	31	5	1	2	-	-	1	40
Signor Campani's	12	-	-	-	-	-	1	13
A note	1	-	-	-	-	-	-	1
total	193	28	19	7	2	8	7	264
	73%	11%	7%	3%	1%	8%	7%	

One item, the book review, has no examples of modality, and is omitted from the table. There are two types of modal expression which were not found in the 3 July issue. One of these is nominal forms. The other is the use of a main verb, usually of a cognitive type, such as *I think*, *I believe*, etc., but whose function is to express modality. This constitutes one form of the phenomenon known in Systemic Functional Linguistics (Halliday 2004, Banks 2005) as grammatical metaphor (Taverniers 2003), abbreviated in the Table as GM. All of the examples of grammatical metaphor occur in Hooke's letter.

The modal auxiliaries, here including *might*, account for 73% of the sample. We will return to these in more detail later.

The other verbal expressions account for 11% of the sample. These include four examples of *be* + infinitive, six of *ought* + infinitive, two of the semi-modal *need*, four of *appear*, one of *require*, and one of *seem*. The following are corpus examples; one example is given for each of the possible realizations:

5. The *other* is, that there must be two *Poppetheads*, into which the *Mandril* must pass, where the *Ring* **is to be fastened** …

6. … but that the small one, sent by him to Cardinal *Antonio*, hath no more *Aperture*, than ordinary ones **ought to have**.

7. Hence he also taketh occasion to intimate, that we **need** not scruple to conclude, that if these two *Planets* have *Moons* wheeling about them …

8. … not believing, that the *Great Dog*, which **appears** to be the fairest Star of the *Firmament*, hath 2 *Seconds* in *Diameter* …

9. … that a *Turn-lathe*, wherein must be two different, and in some manner contrary motions, can move with that exactness and steddiness, that **is required** …

10. … though there be 5 or 6 lesser *Apertures*, of which it **seems** (*saith he*) the Artificer would have those, that use it, serve themselves more ordinarily …

The adjectival category accounts for 7% of the sample. These include one each of *able* and *unable*, two of *capable*, one of *likely*, six of *necessary*, two of *possible*, four of *impossible* and two of *requisite*. The following are corpus examples; one example of each adjective is given:

11. … had considered, what a Man is **able** to see with his *bare* Eye at 60 Leagues distance …

12. … that he is **unable** to work Glasses beyond a certain bigness …

13. … Whereas in the practice, a *Circle* **capable** to keep Sand and Putty, must be of some *breadth* …

14. … and that if there do not happen a change in the magnitude of the *Ring* (as it is not **likely** there does) that must needs proceed from the Constitution of the air …

15. Secondly, He finds it difficult to work these *Great* Glasses of the *same* thickness, which yet is very **necessary**, because, that the the least difference in *Figures* so little *convex*, can put the *Center* out of the *Midle*, 2 or 3 *Inches* …

16. … but only as an Advertisement to those, who light upon the *Theory* of any *Engine*, not to expose it presently as **possible** and useful, before they have tried it …

17. … those, who promise to make him see *Plants* or *Animals* in the Moon (of which I know not any, that has done so, though perhaps there may be some, notwithstanding his Objections, that do not yet think it **impossible** to be done) …

18. … to rest for a long time steddy and firm, as is **requisite** for the not swarving from it a hair's thickness, since less than that can change all.

The adverbial category accounts for 3% of the sample. There are five examples of *perhaps*, and one each of *seemingly* and *probably*. The following are corpus examples; one example of each adverb is given:

19. I must say that his *Objections* to me, seem not so considerable, as **perhaps** he imagines them.

20. … to have a description of a way altogether *New*, and *Geometrically* true, and **seemingly**, not unpracticable, whereof they might make use, or not, as they should see reason.

21. … and very **probably** make their *Moons* turn about them in turning themselves about their *Axis* …

The nominal category accounts for only 1%, with only two examples, one each of *certainty* and *possibility*:

22. … which I cannot now set down with any **certainty**, or accurateness; seeing, they are to be found in no *Map* …

23. For, as to the **possibility** of getting Plates of Glass thick and broad enough without veins, I think *that* not now so difficult here in *England* …

The grammatical metaphors account for 3% of the sample. There are two examples of *I believe*, one of *I conceive*, three of *I think*, and two of *I am apt to think*. The following are examples; these three examples include all five expressions of grammatical metaphor found in the sample:

24. … **I think** *that* not now so difficult here in *England*, where **I believe** is made as good, if not much better Glass for *Optical Experiments*, than ever I saw come from *Venice*.

25. … but yet, **I think**, much easier by *Engine*, than by *Hand*, and of all *Engines*, **I conceive**, none more plain and simple, than that of a *Mandril*.

26. And for making *Spherical Glasses* by an *Engine*, **I am apt to think**, there hardly can be any way more plain, and more exact, than that which I have described …

The anomalous combined forms also account for 3%. Since these combine elements from different categories (e.g. auxiliary + adverb) they constitute a miscellaneous group. There is one each of *can believe possible*, *may perhaps*, *will perhaps*, *would require*, *perhaps may*, and two of the now obsolete *must needs*. Most of these seem to be functioning as fertilized hedges (Banks 1994), that is hedging expressions which reinforce each other. The following are examples; one example of each form is given:

27. … two such Mandrils, which may be made of sufficient strength, length, and exactness, to perform abundantly much more, than **I can believe possible** to be done otherwise than by chance …

28. … what is necessary for the making Glasses of such-bigness; which he believes this *Inventor* **may perhaps** not have thought of.

29. … Which, if he observe the Moon in the *Horizon*, and neer the *Zenith* with a *Telescope*, he will experimentally find; and, having done so, he **will perhaps** not be so diffident in this matter.

30. To penetrate into the *Causes* of the strange Reciprocations of the Tides, **would require** exact descriptions of the Situation, Shape and Extent of every piece of the adjacent Coasts of *Eust* and *Harris* …

31. … since this **perhaps may** be the only means of trying it, supposing, the same matters be used …

32. … but if the *Ring* be bigger, it will a little spread out; and it if were treble, it **must needs** spread out the half of its breadth …

5. MODAL AUXILIARIES

We can now return to the modal auxiliaries, which, as has been seen, account for 73% of the modal expressions in this sample. Table 5 gives the distribution of these.

Table 5. Modal auxiliaries in Philosophical Transactions 5 June.

	may	might	can	could	will	would	shall	should	must	total
A relation	-	-	2	-	-	-	-	-	-	2
Monsieur A	-	-	1	-	1	-	-	-	1	3
Consideration	10	1	11	6	6	24	1	9	11	79
Mr Hook's	10	4	7	3	13	7	3	6	5	
Of a means	2	-	-	-	1	3	-	-	1	7
A further Acc	5	-	6	6	3	1	1	4	5	31
Signor Camp	1	-	2	-	3	4	-	2	-	12
A Note	-	-	-	-	-	-	-	1	-	1
total	28	5	29	15	27	39	5	22	23	193
	15%	3%	15%	8%	14%	20%	3%	11%	12%	

The most frequent auxiliary is *would*, which accounts for 20% of the modal auxiliaries. These are particularly common in Auzout's criticism of Hooke, although it might be noted that since this is the longest item, it would tend to have the largest number of modals anyway, along with the other two relatively long items, Hooke's letter, and Auzout's criticism of Campari's book. The following are corpus examples of *would*:

33. … and finds, that it **would** make but 6 or 7 minutes of inclination, and that a Glass **would** make less *Convexity*, and consequently, less difference from a Glass perfectly plain …

34. What then, *saith he*, **would** becom of a Glass of 10000 feet, which, according to the said Table, **would** have more than four feet, or four feet and nine inches, or five feet, seven inches *Aperture*, and of which the *Ring*, though it were two feet nine inches, **would** have but one minut of *Inclination*, and the Glass of 5 feet *Aperture* **would** have but 4 minuts, and the curvity of it **would** be less than the hundred part of a Line.

The auxiliaries *can* and *may* both account for 15% each. These tend to occur mainly in Auzout's criticism of Hooke and in Hooke's answer, and *can* to a certain extent in Auzout's criticism of Campari. The following are examples of *may*:

35. … whence it **may** be judged, what piece of Glass, and of what thickness it must be, to resist the working.

36. … that so not only the Glass **may** be placed more *Horizontally*, and not slide upon the *Cement*, but that the *Sand* also, and the *Putty* **may** stay upon the Glass.

37. … yet I can assure Monsieur *Auzout*, that it **may** be a very good one, when it is an Inch or two out of it.

The following are examples of *can*:

38. … expence of Money and Time being the onely thing, that **can** excuse those who in matter of *Engines* impart their inventions to the publick, without having tried them …

39. And therefore I **cannot** but make this interpretation of what Monsieur *Auzout* saith in this particular …

40. … yet he doubts not, but that the *shadow* appears on the *Left-side*, considering, that the *Existence* of the *Ring* **can** be no longer doubted of, after so many *Observations* of the *shadow* cast by *Saturn*'s Body upon it …

The auxiliary *will* is almost as frequent, accounting for 14% of the sample. This auxiliary is particularly common in Hooke's answer. The following are examples:

41. For the *Figure* of the *Tool* in that way is presently vitiated by the working of the Glass, and without much *gaging* **will** not do any thing considerable.

42. So that, if he **will** by any Contrivance he hath, give me a *Plane-convex* Glass of 20, or 40 foot *Diameter*, without *Veins*, and truly wrought of that *Figure*, I **will** presently make a *Telescope* with it …

The auxiliary *must* accounts for 12% of the sample, and occurs mainly in Auzout's criticism of Hooke, and to a lesser degree in Hooke's answer and Auzout's criticism of Campari:

43. But next, I **must** say that his *Objections* to me, seem not so considerable, as perhaps he imagines them.

44. … he agrees with *Campani*, that it does appear, yet not as he notes it, seeing that it **must** be sometimes on the one side, sometimes on the other; and towards the *Quadrat* with the *Sun* it **must** appear biggest, as *indeed* he affirms to have seen it himself *this* year …

The auxiliary *should* accounts for 11%, and occurs mainly in Auzout's criticism of Hooke and his answer:

45. But he proceeds to speak of the *Inclination*, which the *Mandril* must have upon the *Plain* of the *Ring*, when the *Ring* **should** have 10 or 12 Inches …

46. For it appears, that the *Objector* is somewhat unsatisfied, that I **should** propound a thing in *Theory*, without having first tried the *Practicableness* of it.

The other auxiliaries are relatively marginal, *could* accounting for 8%, and *might* and *shall* 3% each; the following provide examples of these three auxiliaries.

47. Concerning the *Shadow above*, which *Campani* affirms to be made by the *Ring* upon the Body of *Saturn*, M. *Auzout* judges, that there **could** be no such *Phænomenon* …

48. Next, I have this to answer, that (though I did not tell the *Reader* so much, to the end that he **might** have the more freedom to examine and judg of the contrivance, yet) it was not meer *Theory* I propounded …

49. … I will presently make a *Telescope* with it, that with a single Ey-glass **shall** draw a thousand foot: Which *Invention*, I **shall** shortly discover, there being, I think, nothing more easie and certain.

6. SEMANTIC FUNCTION

When the semantic functions of these modal expressions are considered the results given in Table 6 are found. I would not wish to claim that attributions for this type are always straightforward, nor that there are never cases of ambiguity. Nevertheless, it remains true that I found only a small number of such cases, and where this occurred the attribution is the most likely one, as I saw it. The overall result seems so clear cut, that even if some might disagree with some of my attributions, this would not alter the general picture that the analysis provides.

Table 6. Semantic functions of modals in Philosophical Transactions June 5.

	No	%
epistemic	61	23%
dynamic	192	73%
deontic	11	4%

It can be seen that the overwhelming majority, 73%, of modal expressions are dynamic, a small percentage, 23%, are epistemic, and very few, only 4%, are deontic.

7. A COMPARISON OF THE ISSUES FOR 5 JUNE AND 3 JULY

When the two issues are compared the first point that needs to be made is the fact that the 5 June issue has roughly two and half times more modal expressions than the 3 July issue, 264 in the former, and 105 in the latter. There seem to be two factors which lead to this. First the 5 June issue is much more polemical. It deals with two disagreements, one between Auzout and Hooke, and one between Auzout and Campari, although in this second case, we have only Auzout's presentation of it. Indeed Hooke had the unfortunate habit of throwing out ideas, which he failed to work out in mathematical detail, or to put into practice, but then tried to claim priority when he found that others had subsequently gone further. Among his numerous disputes are those with Newton, and Huygens (Chapman 2005). A second feature which may also lead to increased use of modality is the fact that several of these items deal with astronomical matters, and the use of telescopes. Telescopes were still a recent invention and the problem of chromatic aberration had not yet been overcome. Consequently, the results of astronomical observation might well be less certain than they would be at a later date. For both of these reasons, many of the examples of modality in these issues might be seen as early examples of hedging.

The comparative distributions of modal expressions is given in Table 7.

Table 7. Percentage distribution modal forms 5 June and 3 July

	Aux	Vb	Adj	Adv	Nom	GM	Comb
5 June	73	11	7	3	1	3	3
3 July	62	28	6	2	-	-	3

It can be seen that the 3 July issue has a lower percentage of auxiliaries and a higher percentage of other verbal forms, than the 5 June issue. Nevertheless the auxiliaries constitute by far the largest category in both, with other verbal forms clearly in second place. These two together account for 84% of the 5 June sample, and 90% of the 3 July sample. Consequently other forms are relatively marginal. The distributions for these two issues are fairly similar, so that there is a high degree of coherence between the two issues from this point of view.

The comparative distributions of the modal auxiliaries is given in Table 8.

Table 8. Percentage distribution modal auxiliaries 5 June and 3 July.

	May	Might	Can	Could	Will	Would	Shall	Should	Must
5 June	15	3	15	8	14	20	3	11	12
3 July	38	-	6	2	29	2	3	5	15

In the 5 June issue there are six different auxiliaries which account for between 11% and 20% each, with *would* being the most frequent with 20%. In the 3 July issue on the other hand, two auxiliaries stand out, *may* accounting for 38%, and *will* accounting for 29%. Of the others, only *must*, with 15%, has more than 10%. Consequently, one can say that the distributions of auxiliaries is considerably different in the two issues.

Table 9 compares the semantic functions of modality in the two issues.

Table 9. Percentage distribution of semantic functions of modality 5 June and 3 July.

	Epistemic	Dynamic	Deontic
5 June	23	73	4
3 July	9	88	4

While the dynamic category is by far the most important in both issues, this is slightly less so in the 5 June issue, where epistemic examples are more common than in the 3 July issue. This is due to the more polemical nature of the earlier issue and the fact that it contains more material of an astronomical nature. These features lead to increased use of epistemic modality. Nevertheless, dynamic modality remains by far the most important modal function in both. Deontic modality, on the other hand, is highly marginal in both issues.

Table 10 shows in more detail where the different semantic functions occur.

Table 10. Semantic functions for items 5 June.

	Epistemic	Dynamic	Deontic	Total
A relation	1	3	-	4
Monsieur A	-	3	-	3
Consideration	16	81	3	100
Mr Hook's	29	60	2	91
Of a means	5	7	-	12
A further Acc	9	26	5	40
Signor Camp	1	12	-	13
An Account	-	-	-	-
A Note	-	-	1	1
total	61	192	11	264

It is in Hooke's letter that epistemic modality is most common. There it accounts for 32% (29 out of 91 examples) of the modal expressions. This is twice as frequent as in Auzout's original criticism, where it accounts for 16% (16 out of 100 examples). The other relatively long item, Auzout's criticism of Campari falls half way between the two, with 23% (9 out of 40). This seems to corroborate the hypothesis that a context of criticism leads to increased use of epistemic modality with Hooke's letter being particularly "hedgy".

8. OVERALL RESULTS

To the extent that the two issues can together be seen as a single corpus, Table 11 gives the combined results. However, it can be noted that since there are considerably more modals in the 5 June issue, the combined results can be expected to resemble those for that issue.

Table 11. Modal forms. Combined results 5 June and 3 July.

	Aux	Vb	Adj	Adv	Nom	GM	Comb	Total
5 June	193	28	19	7	2	8	7	264
3 July	65	29	6	2	-	-	3	105
total	258	57	25	9	2	8	10	369
	70%	15%	7%	2%	1%	2%	3%	

The modal auxiliaries are by far the most common form of modal expression accounting for 70% of the combined sample.

Table 12 gives the combined results for the different modal auxiliaries.

Table 12. Modal auxiliaries. Combined results 5 June and 3 July.

	May	Might	Can	Could	Will	Would	Shall	Should	Must	Total
5 June	28	5	29	15	27	39	5	22	23	193
3 July	25	-	4	1	19	1	2	3	10	65
total	53	5	33	16	46	40	7	25	33	258
	21%	2%	13%	6%	18%	16%	3%	10%	13%	

The most common modal auxiliary is *may*, with 20%, followed by *will*, 18%, *would* 16%, and *can* and *must* with 13% each.

Table 13 gives the combined results for semantic function.

Table 13. Semantic functions. Combined results 5 June and 3 July.

	Epistemic	Dynamic	Deontic	total
5 June	61	192	11	264
3 July	9	92	4	105
total	70	284	15	369
	19%	77%	4%	

Dynamic modality accounts for over three-quarters of the modal expressions. This, I would suggest, is due to the concentration on physical observation and experiment in the *Philosophical Transactions*. This can be brought out by comparison with results found for two issues of the *Journal des Sçavans* (Banks forthcoming). The two issues in question are those for 9 and 16 March 1665. The comparison is shown in Table 14.

Table 14. Comparison semantic functions: *Philosophical Transactions / Journal des Sçavans.*

	epistemic	dynamic	deontic
Philosophical Transactions	19%	77%	4%
Journal des Sçavans	26%	51%	22%

While dynamic modality is the commonest function in the *Journal des Sçavans*, it occurs considerably less than in the *Philosophical Transactions*, accounting for only 54%, compared to 77% in the *Philosophical Transactions*. Epistemic modality is a little more frequent in the *Journal des Sçavans*, 26% as opposed to 19% in the *Philosophical Transactions*, but the major difference is the fact that deontic modality, insignificant in the *Philosophical Transactions*, accounts for a respectable 22% in the *Journal des Sçavans*. One of the major differences between the two journals is their scope: whereas the *Philosophical Transactions* was restricted to "natural philosophy", roughly science and technology in our terms, the *Journal des Sçavans* attempted to cover the whole range of human knowledge, including law, the classics, and significantly from our point of view, theology. It is probably this that leads to a significantly greater use of deontic modality in the French journal.

9. CONCLUDING REMARKS

In conclusion we can say that on the basis of the issues of the *Philosophical Transactions* examined, in early issues, auxiliaries constitute the main form of modal expression, but the particular auxiliaries used vary depending on the content of the particular issue.

Criticism can lead to increased use of epistemic modality, but dynamic modality remains by far the major function. This reflects an interest in physical observation and experiment. This is highlighted by comparison with the *Journal des Sçavans*, where a wide scope, including in particular theology, leads to the use of a certain degree of deontic modality.

The title of this article contains an example of *may*. I shall leave readers to decide whether this example is epistemic or dynamic.

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