EPISODES IN ESP

A source and reference book on the development of English for Science and Technology

JOHN SWALES

University of Michigan

PERGAMON INSTITUTE OF ENGLISH

a member of the Pergamon Group

Oxford · New York · Toronto · Sydney · Frankfurt

1985
I

SETTING

The latter Episodes have been principally concerned with approaches to selecting materials for ESP classes and with the roles of those materials in the development of communicative and educational competence. These accounts have, I trust, given some idea of the change and controversy that surrounded ESP principle in the last years of the nineteen-seventies and first years of the eighties. In fact, controversy had arisen from the best of motives. The varied, imaginative and novel answers that we have seen proposed in Episodes Nine to Fourteen are all essentially answers to the same question: How best can the ESP practitioner serve his students? And putting the underlying motivation in this form points to at least one admirable characteristic of most ESP work in the period covered by this volume—its educational responsibility. I do not want, by claiming a tradition of educational responsibility for ESP, to imply in any way that ESP practitioners are ‘superior’ in this respect to their colleagues in other branches of the foreign-language teaching profession. If those of us in ESP have thought long and hard about how best to serve our students’ interests, it is simply because circumstances have tended to make us do so. In circumstances of restricted educational opportunity we have been forced to search out ways of providing maximum educational value.

Those ways have all been responses to particular and often localized experiences, and perhaps we can now see that the recommendations made in previous Episodes have often been overgeneralized. Although the dust has not yet settled, I suspect that old educational truths are beginning to re-emerge. One such truth is that there is nothing so dangerous as a little educational success. A fair proportion of curriculum development work around the world in different subjects and at different educational levels has suffered from a line of reasoning which goes: ‘This worked in situation x, so let’s hope it will work in situations y and z’. In fact, what worked in situation x does not often work in situation y or situation z. There are rarely global solutions to local problems.

As for ESP itself, we are beginning to see that the types of work illustrated in the last six Episodes have greatly extended our options rather than required us to choose between these options. Thus, there is a place for authentic materials but not often a permanent place. There are several different types of team-teaching or collaborative arrangement and which, if any, is to be preferred depends on local factors. Truly preparatory materials (as opposed to rehearsals) have a role to play but only in certain educational contexts. And so on. However, there are two other dimensions of ESP classroom practice that have not been fully brought out in previous Episodes, and for that reason they ought to be mentioned here: the human and the social aspects. The 1978–82 period also saw the rise and fall of the approach to Needs Analysis most prominently represented by John Munby’s Communicative Syllabus Design. In this
approach all the preliminary work is devoted to specifying the particular communicative needs the learner will require if he or she is to perform in the particular target situation. Doubtless Munby's 'Communicative Needs Processor' was applied in ways he would not have approved of, but it did give rise to the view that ESP teaching should be completely instrumental; the learners were apprentices to their needs-driven syllabuses and were to be chained to their benches until they had acquired the necessary skills. Of course, many ESP teachers continued to recognize that their learners were human beings who had wishes and expectations as well as externally-defined needs, but the charge levelled against ESP in the immediate past that it was 'anti-humanistic' or even 'inhumane' had a certain force and has done something to isolate ESP from the rest of ELT (which in that very period was taking a greater interest in humanistic approaches). The second dimension is social and applies particularly to programmes for overseas students going to or already in English-speaking countries. The crude separation of 'social survival' elements (General English) and 'educational survival' elements (ESP/Study Skills) came to be seen as unhelpful and unworkable, and one reason for this was a growing realization that in many cases linguistic, educational and social difficulty were all inter-related.

Indeed, it has been suggested that for some overseas students the greatest threat to their successfully completing their educational programmes is loneliness, rather than lack of language or appropriate study habits. This is because isolation from colleagues is not only unfortunate in itself, but also blocks linguistic and educational advance.

So far in this Setting I have concentrated on that aspect of ESP activity which puts a premium on educational response and responsibility, because this has been a major concern in the Episodess in the second half of this volume. Nevertheless, the other and older tradition of linguistic responsibility had been continuing, even if at times its importance and relevance seemed to have been put at risk by other matters. It therefore seems right to choose for the final Episode a paper that describes research into the characteristics of certain Scientific English texts rather than discusses the place and use of such texts in an ESP programme. With the choice of the paper by Tarone and her co-workers, connection can also be made with the opening Episode by Barber because the first and last Episodes in this volume are the only two (except perhaps for Lackstrom, Selinker and Trimble) that are essentially descriptive of the language of Science. Both papers aim to provide information that will be of use to teachers of EST, but both refrain from indicating how that information might be best used. The two papers also share a concern to be explicit about their research procedures and to be cautious about the wider applicability of their results. Yet there are enormous differences between Barber and Tarone et al. and these differences reflect both our increase in knowledge and our increase in ambition over the twenty years that separate them. I list some of the differences below:

1. Barber took three texts that 'straddled' disciplines and also covered two of the major text-types (textbooks and journal articles) in an attempt to say something about general scientific style. Tarone et al. are extremely restrictive; they have studied two papers from one journal; moreover, the two papers dealt with the same subject. Therefore, when Barber observes that his is 'only a small-scale study, confined to a limited body of material, and this must be borne in mind when the results are considered', this is all the more true of Tarone.

2. Barber is concerned with the frequency of occurrence of a range of syntactic features (such as voice) and certain syntactic structures (such as types of subordinate clauses). Tarone et al. are only interested in voice, and even here with the choice of active and passive in certain contexts.

3. Barber is content to offer statistical information. Tarone et al. are much more ambitious; they are concerned to find an explanation of the use of the passive as opposed to use plus an active verb. They also make use of statistical data but in this case to provide evidence for their findings and to ensure that the reader has sufficient facts to challenge the conclusions if he or she should so wish.

4. For Barber a text is a text; in other words, he makes no attempt to correlate findings with different sections of texts. For Tarone the organizational and discoursal structure of her material is crucial.
Barber worked on his own; for Tarone a key aspect of the research design is to involve a specialist from the content field—in her case an astrophysicist acted as ‘specialist informant’.

Barber is descriptive whereas Tarone et al. are experimental; they develop a set of hypotheses and test them out against their data.

Barber’s work implies no challenge to the adequacy of traditional grammatical explanations such as ‘the passive is used when the agent is unimportant’. Tarone et al., on the basis of their data, offer such a challenge by purporting to show that in their contexts explanations may lie in rhetorical function and rhetorical structure, rather than in single-sentence semantics.

Episode Fifteen is a direct descendant of Episode Six. It reflects the strong American tradition of rhetorical research and its senior author, Elaine Tarone, has become an increasingly influential member of the now-scattered ‘North-Western’ US School of ESP. Indeed, one can even detect some stylistic similarity between the two papers, especially in the way they make claims about originality and discuss findings. On the Use of the Passive in Two Astrophysics Journal Papers is not an easy paper because it does not set itself an easy task. It raises questions of the true nature of explanation of linguistic phenomena—not from the standpoint of the nature of deep linguistic structure, but from the standpoint of the writer of a journal article and the implications he or she should be aware of when making choices in the process of writing that article. In so doing it raises a number of other issues that need to be discussed; one is the matter of the most useful type of categorization of ‘Scientific English’ as a whole; another is whether linguists concerned with syntax are providing the kinds of explanation that the consumers (the ESP practitioners) need; and a third is whether certain contexts preferentially require their own explanations of the use of English or whether a unitary explanation is adequate. In all these matters, Tarone et al. offer us responsible statements about a minute fragment of the enormous volume of scientific writing. As the ESP practitioner must select from that volume and is often placed in the position of having to make observations and offer advice, this final Episode is also only a beginning. Just as I have been stressing the need for a cautious and situationally-modulated acceptance of the ideas of Phillips and Shetlesworth or Johns and Dudley-Evans or Hutchinson and Waters, so the same need for caution applies to the pedagogical use of Tarone et al. In all cases, and in both traditions, the work is full of interest, but it also usually requires some form of verification.

The final Episode is also something of a small celebration in that it signals the appearance of The ESP Journal, the first (and so far, the only) professionally produced and distributed journal in the field.
II

TEXT AND COMMENTARY

On the Use of the Passive in Two Astrophysics Journal Papers*

by Elaine Tarone, Sharon Dwyer, Susan Gillette and Vincent Icke
University of Minnesota

While extensive use of the passive is shown by frequency counts of verb tense and aspect which are performed on corpora combining texts from a variety of scientific and technical fields, significantly different results may be obtained when one compares the frequency of the passive and active voices within a single scientific or technical field. In this paper we examine the frequency of the active and passive verb forms in two astrophysics journal articles, finding that we plus an active verb occurs at least as frequently as the passive in both articles. On the basis of consultation with an informant in astrophysics, we propose four rhetorical functions of the passive as opposed to we plus an active verb: (1) it indicates the author's unique procedural choice, while the passive indicates an established or standard procedure; (2) it is used to describe the author's own work and the passive to describe the work of others, unless that work is not mentioned in contrast to the author's, in which case the active is used; (3) the passive is used to describe the author's proposed studies; and (4) the use of the active or the passive is determined by focus due to the length of an element or the need for emphasis.

Introduction

It has long been accepted that one of the most salient grammatical features of the register of English for Science and Technology (EST), as compared to registers of 'general English', is its relatively frequent use of the passive form of the verb. Frequency counts of verb tense and aspect performed on corpora of data which combine texts from a variety of scientific and technical fields do seem to show that, overall, the passive voice is used extensively in EST (cf. Cooray 1965, Duskova and Urbanova 1967, Fernald 1977, George 1963, and Swales 1976). For example, Robinett (1980) performed such an analysis on a combination of texts from scientific, as opposed to belles lettres fields, and found that when all verb phrases containing be in each group of fields were analysed, 46% of those occurring in scientific texts were passive constructions, while only 29% of those in the belles lettres corpus were passive. The only study of which we are aware which examines the frequency of usage of the passive voice within one particular field is Wingard's (1981) study of verb forms and functions in six medical texts; interestingly, Wingard finds that verbs in the active voice outnumber verbs in the passive.

We are unaware of any other studies which (a) examine the frequency of usage of passive voice within a single field, and within a single genre within that field (e.g. textbooks, journal papers, etc.); or which (b) perform a rhetorical analysis to determine the systematic functions of passive voice, as opposed to active, within the text as a whole. Lackstrom, Selinker and

* Paper presented at the 1981 TESOL Convention, Detroit. We are grateful for substantive comments on the content of this paper to Kathryn Hanges, Tom Huckin, Eric Nelson, our anonymous reviewer, and many others.
Trimble (1970) and Widdowson (1981) have argued for such an analysis in terms of rhetorical function.

In this study we examine the occurrence of passive and active verb forms in journal papers in one field, astrophysics, in order to determine whether writers in this field do prefer the passive over the active, and we investigate in depth the rhetorical functions of these forms.

Procedure
An initial survey of journal papers in astrophysics suggested to us that the passive verb form was not used to such a great extent as we might have expected. For example, we found the following abstract of this type of journal paper:

(1) We study further the flow of accreting material into black holes from Keplerian disks surrounding them. Solving the system of radial structure equations in Schwarzschild geometry for the case where the kinematic viscosity $v = $ constant, we discover a boundary layer at the disk's inner edge, where the flow becomes non-Keplerian. We also show that, despite the operation of viscous stresses across this inner edge and the presence of the boundary layer there, very little extra energy or angular momentum is radiated or transported outward from inside that radius—a result many have often assumed but no one has carefully demonstrated. These results constitute a solution to the problem of adequately describing the flow across the inner edge and properly setting the boundary conditions there and at the event horizon. (Stoeger 1980: 216, italics ours)

The use of active verb forms here, particularly the first person plural verb form, seemed quite unusual in light of the usual assumption that the passive voice predominates in scientific and technical English.

We therefore undertook to examine in more detail the frequency of occurrence of the active and passive forms of the verb in two journal papers in the field of astrophysics, and to investigate in particular the rhetorical function of the passive in these texts. The two papers chosen for our investigation were both published in *The Astrophysical Journal*, and focus on research into the nature of black hole accretion disks:

---

1 The *Manual of Style for the Astrophysical Journal* (University of Chicago Press, 1971) makes no recommendations at all regarding the use of the active and passive voice. Rather, authors are asked to 'at least attempt to conform to the elementary rules of grammar, syntax and punctuation'. Authors are warned to beware of only three common types of error: unattached participles, subject and complement of different numbers, and a sequence of nouns piled one on top of the other in Germanic tradition'. Aside from this, it is simply suggested that authors examine current issues of the *Journal* to familiarize themselves with the conventions.

2 Five of Wingard's six texts were medical journal papers. It is indeed true that in these texts active verbs outnumber passive verbs but the *preponderance* of the active is less marked than in the two journals analysed in this Episode. The overall percentage of passives would seem to be in the 35–40% range. If existential uses of BE are excluded (see Episode One note 4b) then the frequency of actives and passives is broadly similar.

3 It is worth noting the use of 'genre' here. There is a growing contemporary interest in 'audience analysis' and how this can be related to the achievement of communicative purpose. As a result, understanding the intended relationship between writer and reader has so increased in importance that conflating findings from, say, textbooks and journal articles (as we have seen in Barber and Haddleton) is no longer a generally acceptable procedure. Work in 'genre-analysis' is taken up again in the Prospect.

4 We can see that Tatone et al. have two aims and one is to check out the facts about the use of active and passive, and here I think we have to say that two short articles are an inadequate sample. The other aim is to 'investigate in depth the rhetorical functions of the forms', and this is the aspect of the article that justifies its inclusion in this volume.

5 The footnote to the style-manual is another instance of a current concern to discover and evaluate the opinions of professionals involved in the genre. Until recently, it was generally argued that the only admissible data were the texts themselves; today at least some researchers are interested in discovering what the users of certain communicative conventions believe to be the rationale for those conventions.

In our count and analysis, we counted finite verb phrases. We did not include bare -en participles such as 'the figures given'. (See Swales (1981) for an excellent discussion of bare -en participles.) Neither did we count verbs in footnoters or captions to charts. We did not count the symbol = as a verb, though at times it seemed to function as a verb, as in 'namely that po = po(r)'. We counted as passive all verbs which appeared in the subject + be + verb + -en form, regardless of whether they were true passive or stative (see Lackstrom, Selinker and Trimble 1970 for a discussion of passive and stative in EST). We decided to disregard the difference between passive and stative in our count because there were some cases in which it was difficult to clearly distinguish passive and stative based solely on context. We determined the number of active and passive verb forms used in these papers, section by section, and in the papers as a whole. We formulated hypotheses as to the apparent rhetorical function of choices between active verbs and passive verbs. One of us (V.1.) provided the astronomical interpretation of the text, and outlined the overall rhetorical structure of these papers.2

Results
A. Frequency of Active and Passive Verb Forms
We were particularly interested in those uses of the active form of the verb which represented a clear decision to use either first person plural active we or the passive in referring to one's own research, as, in the Stoeger paper:

(2a) Previously (Stoeger, 1976b) we pointed out that the usual way of placing boundary conditions at r_{in} was inadequate and misleading. (p. 216)

where the passive was clearly possible, as in our own paraphrase of (2a):

(2b) Previously (Stoeger, 1976b) it was pointed out that . . . (our paraphrase)

So, in addition to counting all active verb forms, we counted a sub-category of these: first person plural active verb forms. Then, because we were interested in examining those cases

2 See Selinker (1979) on the importance of EST research of working with subject-verbs specialists as well as with linguists. We cannot stress enough the importance of like's contribution to our analysis. His knowledge of the subject matter was absolutely essential to our analysis of the rhetorical structure of these papers. like, while not a native speaker of English, was a native speaker fluency and no perceivable accent. Further, he acts as a reviewer of papers in astrophysics for professional journals, and has very strong intentions regarding the rhetorical and grammatical structure typically used in good writing in this field. Finally, we should point out that he checked and verified his interpretation of these two papers with several members of the Department of Astronomy at the University of Minnesota.

(e) See Peter Roe (Episode One, Related Readings) for an interesting analysis of equations and formulas embedded in technical texts.

(f) As noted (d) above and footnote 2 suggest, the contributions of specialist informants have proved valuable. There remain a number of unanswered—and perhaps unanswerable—questions, however. Is a specialist informant necessary? Or can a wider coverage of data compensate? Who is the real specialist informant? In this case, is it like? Or is it Stoeger and Lightman for their respective papers? In fact, there is some very recent work which has used the original author as specialist informant, but as we know from literary criticism, there may be problems attached to taking the author's own views at face value.

(g) There exists a large but rarely illuminating literature on the reasons for the use of the passive both in studies of General and Scientific English and in both scholarly and pedagogical grammars. The decision by Tarone and her co-workers to concentrate their attention on contexts in which a real choice of voice has been made will lead to very interesting results, and is probably the key research design feature of their paper.
where a clear decision had been made to use active or passive verb forms, we counted again, this time omitting the existential verbs to be, to have, to exist, to become and to get (when used in the sense of become), none of which has a passive form. The results of our frequency count of the active and passive verbs used in these papers appear in Table 1. (A breakdown of the frequency of usage of active and passive in each section of the papers appears in Appendices A and B).

### TABLE 1

| Overall Frequency of Active and Passive Verbs* in the Stoeger and Lightman Papers |
|-------------------------------|-------------------|-------------------|
|                               | Stoeger           | Lightman          |
| Total Number of Verbs\(\d\)  | 244               | 370               |
| Active Verbs                  | 217 (88.5%)       | 301 (81.4%)       |
| Active we Verbs               | 58 (23%)          | 40 (10.8%)        |
| Passive Verbs                 | 27 (11.5%)        | 69 (18.6%)        |
| Total Verbs,                 | 110 (80%)         | 179 (72.2%)       |
| Existentials Omitted\(\d\)   | 52 (37%)          | 40 (16.1%)        |
| Passive Verbs                 | 27 (20%)          | 69 (27.8%)        |

* There was only one we passive in our entire corpus (including both papers: 'We are faced . . .'). (Stoeger p. 218). There were no occurrences of the verb to be in the first person plural we form.

* The percentages here are determined by dividing the total number of verbs into the total number of active verbs, active we verbs (subset of the former), and passive verbs. Existential verbs are included in the corpus here.

* Here the percentages are determined by dividing the total number of verbs excluding the existential verbs to be, to have, to exist, to become, and to get (in the sense of become) into the total number of active verbs (excluding existentials), and so on. We felt it was important to look at the percentages in this way as well, in order to eliminate any possible bias in the data which might make it seem that the active was used more frequently than the passive when in fact it wasn't. While the difference between active and passive usage is somewhat reduced when we look only at nonexistential verbs, we can still see a clear preference for the active over the passive.

In both papers, active verb forms greatly outnumber passive verb forms, regardless of whether existential verbs are counted. If we look only at the incidence of active we verb forms as opposed to passive, we find that Stoeger uses about twice as many first person plural active we forms as passive; in the Lightman paper there are more passives than active we forms.5

We feel we can say that, while there does seem to be some individual variation in the frequency of active we verb forms and passive verb forms, the overall tendency for both writers is to prefer the active to the passive. Icke maintains that, while he feels that the Lightman paper is better written than the Stoeger paper, he does not feel that either author is unusual in his use of the active verb form as compared with others in the field of astrophysics. Thus, if these two papers are representative of the writing style in this field, it would seem that in professional journal papers in the field of astrophysics, the passive verb form occurs much less frequently than the active, and that the first person plural we verb form occurs just about as often as the passive.

5 It is interesting to note here that, while Lightman used fewer we subjects than Stoeger did, Lightman also used the impersonal subject one (as in, 'One may think of the system . . .') 12 times. Stoeger, on the other hand, never used one as the subject. Lightman's combined tokens of we and one as subjects amount to 52, or 21% of the subjects of his nonexistential verb phrases.

\(\d\) But we need to remember that on the available evidence, this preference is less clear in other data.

\(\d\) Further research may well show that this is a rather big 'if'.

194
B. Rhetorical Function of the Passive and Active Verb Forms

What is the rhetorical function of the active and passive verb forms in these two professional journal papers? When do the authors prefer the active over the passive? We outline below four generalizations which we claim account for the use of active and passive verb forms in these papers. The first three generalizations are, we believe, specific to writing in this genre, i.e., journal papers in astrophysics. It may be that future research will show these three generalizations to be true for related fields, such as physics or chemistry, in the same genre. To our knowledge, this is the first time these generalizations have been made and documented in the literature. The fourth generalization is commonly accepted for 'general English' usage of the passive and active voices.

It should be pointed out that the first three generalizations may be taken as having both a strong and a weak interpretation. The weak interpretation is that the generalizations will apply only when a verb which can be passivized is used. That is, the selection of verb is made first, and then, if that verb can be passivized, the generalizations apply. The strong interpretation is that the author will use vocabulary and locutionary devices to ensure that if the generalization calls for a passive, the passive will be used. So, if the generalization calls for a passive, the author will use the verb which can be passivized over the verb which cannot. That is, rhetorical and syntactic choices are made first, and then the lexical verb is used which fits into that structure. It is possible to conceive of either interpretation of the following generalizations, and the data may enable us to select one or the other. However, it may also be that neither interpretation is completely correct. The writer may at times be influenced in use of voice by the nature of the verb previously selected, or s/he may at other times reject one verb and use another in order to use the desired voice.

Generalization 1: Writers of astrophysics journal papers tend to use the first person plural active WE form to indicate points in the logical development of the argument where they have made a unique procedural choice: the passive seems to be used when the authors are simply following established or standard procedure, as in using accepted equations or describing what logically follows from their earlier procedural choice.

---

*We thank The ESP Journal's reviewer for these observations regarding the strong and weak interpretations of our generalizations.*

---

(a) In contrast to the previous commentary note, at this point Tarone et al. seem unnecessarily restrictive when they state that 'the first three generalizations are, we believe, specific to writing in this genre, i.e., journal papers in astrophysics'. As we shall see, the generalizations do not seem to relate to specific conceptual structures of Astrophysics, but rather to decisions whether to use either first person plural active or or the passive in referring on one's own research. Thus, there must be some expectation that in the genre of journal articles and in the context of the decision just referred to the three generalizations would at least be relevant to our understanding of the rhetorical function of voice-alternation in other fields. It is not that Tarone's highly intriguing generalizations are 'specific' to Astrophysics, but that so far they have only been attested in that subject area.

(b) An interesting discussion, but one slightly distanced from most people's introspection into their composing process. In fact, it would seem that if there is an early and preliminary rhetorical choice it is that of subject rather than of the lexical or syntactic shape of the main verb-predicate.

(c) Generalization I opens up all sorts of possibilities. For one thing, it questions much of the received wisdom about adopting a consistent 'narrative style', i.e., either use we or the passive. For another, it can be related to thematic subject-in the sense that we as subject indicates that we have done something noteworthy. But most interesting of all is whether the choice of we or passive has predictive value for the regular reader of the genre. Modern discourse analysts, especially those working with Professor John Sinclair at the University of Birmingham, have considerable interest in predictive structures and predictive signals in texts. It would indeed be interesting to see whether (in this case) astrophysicists encountering a sentence beginning with we plus active verb have immediate expectations of a 'unique-procedural choice' about to be made.
The overall rhetorical structure of a professional journal paper in astrophysics takes the shape of a logical argument in which the author attempts to solve a problem by choosing from among various accepted procedures and equations that combination which will best solve the problem. The use of the active and passive forms of the verb in such a way as to mark those points at which the authors are making such choices is very common. Since the entire structure of these papers is made up of such a logical argument, there are a great many cases where choices are being made, or accepted procedure implemented (equations 'plugged in' at the appropriate time, and so on). Usually, the typical structure of theoretical papers such as those analysed here shows a marked 'inverted pyramid' design, as illustrated in Table 2. Thus, there is a gradual narrowing down of the scope of the paper, as the writer makes a series of choices; these choices are guided by a mixture of intuition, common-sense, technical ability, experience, luck, and so on. It is at these choice points that the writer will tend to use the first person plural active use. Where established or standard procedure follows from these choices, the passive is used. Table 2 makes clear the way in which both the Stoeger and Lightman papers follow this logical structure. In the Stoeger paper, for instance, Section I corresponds to 'general physics and all observations', Section II to 'general physics and special observations', and so on.

**TABLE 2**

Logical Structure of a Theoretical Paper in Astrophysics with Glosses* for Stoeger and Lightman Papers

<table>
<thead>
<tr>
<th>Content</th>
<th>Choice Made by Writer</th>
<th>Stoeger section</th>
<th>Lightman section</th>
</tr>
</thead>
<tbody>
<tr>
<td>general physics and all observations</td>
<td>choice as to what phenomena to explain</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>general physics and special observations</td>
<td>choice what physics are likely to be relevant</td>
<td>II</td>
<td>II</td>
</tr>
<tr>
<td>specific physics and observations</td>
<td>choice what specializations and approximations to make to simplify the equations</td>
<td>III</td>
<td>III, VI, IX</td>
</tr>
<tr>
<td>specific equations</td>
<td>choice of boundary conditions, picking out a few solutions among many</td>
<td>IV, V</td>
<td>IV</td>
</tr>
<tr>
<td>specific solution</td>
<td></td>
<td>VI, VII, VIII</td>
<td>V, VII, VIII</td>
</tr>
</tbody>
</table>

*Glosses provided by Icke.

Below we provide several passages from the two papers, together with glosses' in the margins to indicate where the author has made a unique procedural choice or followed established procedure.

*Glosses provided by Icke.
In this paper we develop the theory of time-dependent disks. The underlying physics is essentially the same as that of the stationary models above, except that we allow variables to evolve in time on the 'drift' (radial flow) time scale ... (Lightman p. 419)

(4) The fundamental variables we will use are: ... The laws governing these variables are delineated below: ... (Lightman p. 420)

(5) At this point we do not need any details of the shear stress ... The fluid shear is simply derived from the assumed Kepler (orbital) velocity of the gas ... (Lightman p. 420)

(6) From our assumption of radiative transport (assumption x of II) as the energy transport mechanism and assumptions vi and vii, the radiative transport is described by the radiative diffusion equation ... (Lightman p. 421)

(7) For $r > r_m$, there is a definite sense in which we can neglect viscosity—in that the flow follows, to good approximation, the circular geodesics. (Stoeger p. 218)

(8) Because we want to focus our attention on the flow across $r_m$, a problem of radial structure, we assume for our purposes that $h = constant$ ... (Stoeger p. 217)

(9) Iteration can be continued. It turns out, however, that the first two iterations give satisfactory results ... (Stoeger p. 219)

(10) Energy is generated locally by viscous heating through action of the shear stress $\sigma r$. (Lightman p. 422)

(11) But they do not readily lend themselves to detailed modelling ... (Stoeger p. 216)

There are a great many more examples of this sort—more than we can include in a paper of this length.

There are also a few exceptions to Generalization 1 in the Stoeger paper, though not in the Lightman paper. These possible exceptions appear below, together with some discussion.

Here, the insertion of expression 13 into equation 16 was not standard procedure, but an earlier design choice of the writer. As a procedural choice, Generalization 1 suggests use of the active voice here. However, the writer may be using both the past tense and the passive voice here in order to highlight the fact that this was an earlier procedural choice; Generalization 1 does call for use of the passive in describing what follows from an earlier procedural choice. (It is interesting to note that all our earlier examples of established procedure showed the passive being used in the present tense.)

Then, if $x$ is taken to be of order unity within the layer in the region $r > r_m$ ... (Stoeger p. 219)

Here again, making $x = 1$ is not standard procedure, but a choice of the writer. It is less easy to see here why the passive is used. It is worth noting with regard to both these exceptions that, as we have pointed out above, leke is rather critical of Stoeger's writing style in general. He is particularly critical of (13) above, feeling that such examples do not provide 'clear signals' to the reader of the writer's line of argumentation.

In that only two exceptions were found in these two papers, and that a great many examples were found in support of Generalization 1, we believe that there is ample evidence to conclude that this first generalization is indeed characteristic of writers of astrophysics journal papers.


(10) By this time the reader may well have become convinced that Tarone et al. are on to something, and that the exceptions are both marginal and to be expected.
Generalization IIA: When these authors contrast their own research with other contemporary research they use the first person plural active for their own work, and the passive for the work being contrasted.

Generalization IIB: When these authors cite other contemporary work which is not in contrast to their own, they generally use the active form of the verb.

This second generalization holds for those portions of the astrophysics paper which deal with the review of the relevant literature. At first glance, it would seem that Generalization I, and IIA and B, are too similar to be included as separate generalizations. There are, however, two differences between I and II. First, contemporary literature on a given physical phenomenon and established procedure in the field of physics are not the same. In this case established procedure refers to systems of physics such as Keplerian physics or Schwarzschildian geometry, composed of long accepted paradigms. Contemporary works, however, usually attempt to describe specific physical phenomena in terms of the established systems, just as the two authors we have chosen to study have done, these interpretations may be subject to discussion by other physicists.

Secondly, Generalizations I and II apply at different levels of generality. Generalization II applies at a lower level of generality, stating that within this section of the paper, the writer highlights the contrast between his/her own work and other contemporary work in contrast by the use of voice. Generalization II A may at first seem similar to Generalization I, in that the active is used for one’s own unique contribution to the field (IIA) as well as for unique procedural choices (I). However, Generalization IIB also calls for the use of the active for other work not in contrast to one’s own; it seems to us that such ‘other work’ may or may not be viewed as unique contributions to the field. It seems to us to be an entirely different criterion used here in Generalization II—a criterion operating at a lower level of generality, and one which focuses on whether other work is in contrast to one’s own work or not, rather than on the issue of ‘choice vs. established procedure’.

We will provide several examples which seem to support Generalization IIA, together with seeming exceptions to IIA, and then we will provide the examples supporting Generalization IIB to which there are no exceptions in these papers.

(14) In this paper we discuss an aspect of accretion disk structure which has never been adequately dealt with . . . (Stoeger p. 216)

(15) All of the accretion disk models of the above authors are time-independent. A constant mass flux for the normal star into the disk is assumed. In this paper we develop the theory of time-dependent disks. (Lightman p. 419)

(16) In the actual literature on stationary disks, the function H(T) and consequently the multiple- and no-root phenomena are not encountered because the equations are solved under the imposed restriction of equation (34) and done so not exactly, but only approximately . . . (Lightman p. 427)

(17) In all previous calculations involving stationary disks (e.g. SS & NT) the dimensionless viscosity parameter has been assumed to be constant. The assumption probably becomes increasingly tenuous as an increasing degree of time dependence is allowed in the problem and as one looks at shorter and shorter time scales. We shall make the assumption that α is constant in radius and time on the drift time scale . . . (Lightman p. 433)

Clearly, in examples (14)–(16), it is the first person plural active form of the verb which is used to refer to one’s own work in contrast to the work of others, which is described in the

(a) Note that the authors of this Episode are perfectly willing to accept that some observations are confined to sections of texts rather than texts as a whole; in this instance they are suggesting precisely how Stoeger and Lightman deal with the relevant literature.
passive. In (17) also there seems to us to be a definite contrast between the first two, and the last, verb phrases in the passage: has been assumed and is allowed versus shall make.

The verb phrase looks seems to be less clear; this may be an exception to the strong version of IIA. The weak version of this generalization stands here, however, as look cannot be passivized. If we wish to argue for the strong version of Generalization IIA, we can point out that the subject of the verb is the abstract and impersonal one, and thus can perhaps be viewed as equivalent to the passive in some way. This is a weak argument however. A stronger argument is that Lightman is not just referring to other work here; he is criticizing it and building the case for his own choice of assumptions. As he moves from assumptions of others (passive voice) to a criticism of the limitations of these assumptions (passive and active) to his own work (active), voice shifts accordingly.

Another possible exception to IIA follows:

(18) Though our discussion is confined to geometrically thin, Keplerian accretion disks, the results are pertinent ... Our discussion is also specialized to Schwarzschild geometry—but generalization to Kerr is straightforward. (Stoeger p. 216)

Here, it could be argued that in (18) Stoeger is not really contrasting his own work to that of others. Rather, the use of passive may follow from Generalization I, as Stoeger is describing the limits placed on his discussion by established procedure following from earlier choices.

Evidence for Generalization IIb (that the active form of the verb is used when other work is not being contrasted with one's own) is cited below:

(19) This will be true near $r_{m}$. And it generalizes Lynden-Bell's (1976) results obtained from the Newtonian equation to the general relativistic case. (Stoeger p. 219)

(20) In fact, Pringle (1974) and Cunningham (1973) have developed models of vertical structure which suggest that the inner region of the disk is convectively unstable ... (Lightman p. 426)

(21) Rees has pointed out (see Pringle et al. 1973) that failure of the above requirement leads to a thermal instability ... (Lightman p. 420)

(22) In these models the elements of the accreting fluid follow circular geodesics to very good approximation ... (Stoeger p. 216)

No exceptions to Generalization IIb were found.

Generalization III: When these authors refer to their own proposed future work, they use the passive.

However, we can note that a first person pronoun is still used though in the possessive; at the end of the day there seems little rheonal difference between:

(18) Our discussion is confined to ...
(18c) We confine/restrict the discussion to ...

And we can also notice that the second verb (is specialized) does not allow a straightforward [we plus active verb] formulation. I think it is possible, therefore, that further work would show that [our + NP] might well need to be incorporated within a more complex analysis—an analysis that would include nominalized variants of 'reporting' verbs.

Although Generalization IIb may work for these two texts, there is no doubt that it is the one most likely to fall down when applied to literature review sections in other papers. A number of other structures are well attested. Consider these alternatives to (20):

(20a) Models of vertical structure have been developed by Pringle (1974) and Cunningham (1973) which suggest ...

(20b) Models of vertical structure have been developed which suggest ... (Pringle 1974; Cunningham 1973).

(20c) In some models of vertical structure the inner region of the disk is convectively unstable (Pringle 1974).

This is not the place to discuss possible factors affecting a choice from (20a) to (20c) (but see below, under 'Related Readings'). However, we can note that in one of these two journal-author pair to adopt a consistent preposed-researcher-as-subject orientation. Such an orientation may be personal or preferred by the journal. Other orientations are widely used.
There seems to be ample evidence that the authors tend to use the passive when referring to their own proposed future work. The main exceptions are Lightman's references to Paper II, which actually is not 'future work', but rather a paper written simultaneously with this paper, Paper I. (The submission dates of both papers are the same, and they appear contiguously in volume 194 of The Astrophysical Journal.) Several examples of the use of the passive to refer to future work are:

(23) This will be dealt with in a succeeding paper. (Stoeger p. 222)
(24) Whether such a situation is stable under perturbations will be investigated in Paper II. (Lightman p. 427)
(25) In this section we give exact, although implicit, solutions for those variables in terms of $\Sigma$, which are valid in all regions and which will be used in future numerical work (see Paper II). (Lightman p. 424)

A possible exception to Generalization III appears in example (26), where Stoeger uses one active and one passive verb form to refer to future work.

(26) It will be interesting to see what happens when these considerations are extended to Rosen's bimetric theory of gravity. (Stoeger p. 223)

The weak version of III is preserved here, as happen is not passivized. However, the verb is obtained could have been substituted for happens here, so this must be considered an exception to the strong version of Generalization III.

Another possible exception is:

(27) Hopefully further observationally oriented theoretical work along these lines will yield results . . . (Stoeger p. 223)

Again, the weak version of III is preserved here, as yield does not seem to have a workable passive in this context. We also are uncertain whether Stoeger is referring to his own future work here, or that of others; if he is referring to the work of others, the strong version of III is not violated here.

The only other exceptions to III are from Lightman's references to companion Paper II:

(28) In a companion paper (Lightman 1974, hereafter referred to as Paper II) we solve our evolution equation and auxiliary equations numerically . . . (Lightman p. 419)
(29) In our explicit models (see Paper II) equations (18), (19) & (20) will turn out to be satisfied . . . (Lightman p. 423)

Example (28) is clearly an active voice. Example (29) may be considered a passive, if the aspectual verb is not considered. If the aspectual verb is considered, it can be pointed out that turn out doesn't have a passive form, and thus is no problem for the weak form of Generalization III.

However, even if we want to argue for the strong interpretation of Generalization III, we believe that these two examples are not really problematic. This is because of the ambiguous nature of Paper II, mentioned earlier. Paper II has actually been written simultaneously with the present paper and is not 'future work' in one sense. The fact that the writer wavers between active and passive voice in referring to Paper II (see examples (24), (25), (28), (29)) probably reflects the fact that the paper itself can be viewed as either future work (not yet published) or as current other work (submitted simultaneously with Paper I). If Paper II is viewed as the latter, then Examples (28) and (29) are simply illustrative of Generalization IIIB: they are examples of Paper II viewed as other work not in contrast to Paper I.

A remarkable finding, and one which should be worth further investigation. Indeed the whole discussion of Generalization III is a model of careful and explicit linguistic and rhetorical analysis.
Generalizations I, II and III seem to us to be specific to the sort of English used in writing professional journal papers in astrophysics; at least, we are not aware that such generalizations have been made about other genres of English writing. Further investigation is needed to determine whether professional journal papers in other theoretical fields (such as other areas of physics, for example, where similar sorts of logical argumentation guide the development of the paper) use active and passive verbs in similar ways.

Generalization IV seems to be descriptive of general English patterns as well as patterns found in these papers. This generalization has been discussed in grammar books such as Quirk et al. A Grammar of Contemporary English (1972).

Generalization IV: The use of active as opposed to passive forms of the verb seems to be conditioned by discoursal functions of focus—as when the author chooses to postpone or to front certain sentence elements for emphasis—or by the excessive length of those elements.

One of the most striking characteristics of the sentences used in these papers is the fact that lengthy equations are embedded within them, and must be arranged in such a way as not to interfere with the reader's processing of the basic grammar of the sentence. Because of end-weight such equations are often placed at the ends of clauses, and the use of active or passive verb forms is often conditioned by this requirement. We did not notice any overall influence towards either active or passive voice here.

(30) The radiative transport is described by the radiative diffusion equation

\[ q = - \frac{1}{\kappa p \sigma T} \]

(31) Equating the two temperatures, for example, yields:

\[ \Sigma_{crit}(r) = 0.15 \left( \frac{r}{M} \right)^{1/2} \alpha - \frac{1}{8} \]

Conclusion

To summarize, then, we have found that a count of active and passive verb forms in two professional journal papers in astrophysics shows that the active voice is used much more frequently than the passive, and, more importantly, that the active first person plural we verb form seems to be regularly used at strategic points in these papers. An investigation into the functions performed by the active and the passive verbs in these two papers has allowed us to make the following generalizations:

Generalization I: Writers of astrophysics journal papers tend to use the first person plural active we form to indicate points in the logical development of the argument where they have made a unique procedural choice; the passive seems to be used when the authors are simply following established or standard procedure, as in using accepted equations or describing what logically follows from their earlier procedural choice.

Generalization IIA: When these authors contrast their own research with other contemporary research they use the first person plural active for their own work, and the passive for the work being contrasted.

Generalization IIB: When these authors cite other contemporary work which is not in contrast to their own, they generally use the active form of the verb.

Generalization III: When these authors refer to their own proposed future work, they use the passive.

Generalization IV: The use of active as opposed to passive forms of the verb seems to be conditioned by discoursal functions of focus or by the excessive length of certain sentence elements.

(*) A short but lucid discussion of a very complex topic.
We have pointed out that the first three generalizations seem so far to be specific to these papers, or perhaps (though future research will have to verify this) to other papers in professional astrophysics journals or in professional journals in physics or chemistry. The fourth generalization has been established for general English, and is merely noticeable here because of the need for the embedding of lengthy equations.

Huckin (personal communication) has asked whether our four generalizations ever conflict with one another, and if so, which one wins out. At this point, we do not know. However, we suspect that some of the apparent exceptions to our generalizations (notably [18] but also perhaps [28] and [29]) may be due to such a conflict. More research is needed to investigate this problem.

It should be noted that we only claim these generalizations to hold for professional journals. We would expect that the predominance of the active verb form relative to the passive would not be found in popular journal papers on astrophysics, as for example, survey papers in the *Scientific American*. Such papers tend to be summaries of research in the field, with minimal reference to the authors' own work, whereas the major thrust in the professional journal papers we have just described is the reporting of one's own work within a fairly set logical framework, and the contrasting of that work to the work of others. Our first three generalizations would thus not seem to be applicable to the *Scientific American* papers, since different rhetorical functions are required in the two types of papers.

We believe that more research of this type is needed into the use of the active and passive forms of the verb. It should not simply be assumed that the passive is generally used more frequently in EST. The complexities of the picture should also be investigated: Is the passive used more frequently in all genres of EST? If not, why do we find variation in its usage? How do voice and tense interact? Do our four generalizations ever conflict with one another? If so, which one holds? It is extremely important to determine what rhetorical functions condition the choice of the passive in particular EST genres. Only when we have addressed these issues will we be able to provide accurate information to students of EST.

---

*We thank William Perry for drawing our attention to related *Scientific American* papers.*

(i) Tarone et al. are at pains to distinguish between professional and popular journal papers and they surely are right to do this. However, such distinctions lead us to consider whether there are usefully identifiable sub-types within the two broad categories, and whether any established sub-types are restricted to particular fields or are more general. To my mind, these are questions for the eighties and in attempting to answer them we need to evaluate the virtues and vices of complicated sub-categorizations.

(a) Some of these questions, and the ones raised under note (i), are considered in items listed in the related readings.
# APPENDIX A

Frequency of Usage of Active and Passive Verb Forms in Stoeger (1980)
Arranged by Section and as a Whole

<table>
<thead>
<tr>
<th>Section of Paper</th>
<th>Total Verbs</th>
<th>Active Verbs</th>
<th>Total Passive Verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>With we</td>
<td>With Exis.</td>
</tr>
<tr>
<td>Abstract</td>
<td>8</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>I. Introduction</td>
<td>31</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>II. Basic Equations</td>
<td>36</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>III. Boundary Layer Approach</td>
<td>58</td>
<td>11</td>
<td>32</td>
</tr>
<tr>
<td>IV. Approximation Scheme and Solution</td>
<td>23</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>V. Matching with the Keplerian Models</td>
<td>41</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>VI. Characterization of Flow</td>
<td>12</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>VII. Energy and Angular Momentum</td>
<td>23</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>VIII. Conclusion</td>
<td>12</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>COLUMNS TOTALS</strong></td>
<td><strong>244</strong></td>
<td><strong>58</strong></td>
<td><strong>107</strong></td>
</tr>
</tbody>
</table>

* includes one use of passive with we ("we are faced with ")
** includes one use of first person singular ("I have included ")
*** includes one use of first person singular ("I am indebted to ")

Percent of Total Verbs $\times$ 244

% Active Verbs = 88.5%
% Passive Verbs = 11.5%
% Active we Verbs = 23%

Percent of Total Verbs with Existentials Omitted $\times$ 137

% Active Verbs = 80%
% Passive Verbs = 20%
% Active we Verbs = 37%
## APPENDIX B

Frequency of Usage of Active and Passive Verb Forms in Lightman (1974)
Arranged by Section and as a Whole

<table>
<thead>
<tr>
<th>Section of Paper</th>
<th>Total Verbs</th>
<th>Active Verbs</th>
<th>Total Passive Verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>With we</td>
<td>With Exs.</td>
</tr>
<tr>
<td>Abstract</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I. Introduction</td>
<td>23</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>II. Assumptions and Approximations</td>
<td>57</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>III. Fundamental Equations</td>
<td>45</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>IV. Model for Viscosity and Resultant Equations</td>
<td>28</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>V. Approximate Regional Solutions</td>
<td>11</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>VI. Discussion of Consistency</td>
<td>48</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>VII. Reduction of Equations</td>
<td>32</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>VIII. Temperature Function and Solution Regimes</td>
<td>81</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>IX. Comparison with Stationary Models</td>
<td>37</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

**COLUMN TOTALS**

<table>
<thead>
<tr>
<th></th>
<th>Total Verbs</th>
<th>Active Verbs</th>
<th>Total Passive Verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>370</td>
<td>40</td>
<td>122</td>
</tr>
</tbody>
</table>

* includes two uses of first person singular

Percent of Total Verbs

\[
\text{\% Active Verbs} = \frac{81.4\%}{\text{370}}
\]

\[
\text{\% Passive Verbs} = \frac{18.6\%}{\text{370}}
\]

\[
\text{\% Active we Verbs} = \frac{10.8\%}{\text{370}}
\]

Percent of Total Verbs with Existentials Omitted

\[
\text{\% Active Verbs} = \frac{72.2\%}{\text{248}}
\]

\[
\text{\% Passive Verbs} = \frac{27.8\%}{\text{248}}
\]

\[
\text{\% Active we Verbs} = \frac{16.1\%}{\text{248}}
\]

References


George, H. V. (1963), 'A Verb-Form Frequency Count.' English Language Teaching 18, 1: 31–37.


