CHAPTER-IV

A STUDY OF SCIENTIFIC RESEARCH ARTICLES
BY NON-NATIVE USERS OF ENGLISH
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4.1 Basic Format of Scientific Research Articles by Non-Native Users of English

The format of scientific research articles by non-native users of English is based on such distinct constituents which incorporate Introduction, Method, Result and Discussion sections. This format marks an intrinsic formulation of scientific facts and findings. Hence it is followed by the entire scientific community.

As a matter of fact, the conceptual frames and conventions that constitute the basic format of scientific research articles are shared by both native and non-native users of English.

The set format of scientific research articles which is followed by the entire scientific community is indicative of objectivity, universality and uniformity.

It also needs to be mentioned that whatever country or community the scientists belong to they are bound to follow the Journal’s set patterns and conventions. Therefore their research articles have to be in consistence with the Journal’s requirements and ‘Instructions to the Authors’. A corpus of 8 scientific research articles by non-native users of English
have been drawn from Natural Sciences (refer to appendix). These scientific research articles have been analysed in the light of Swale's (1990) model in order to explore the set format and linguistic features which govern varied segments of scientific research articles. It was Swale (1990) who gave pioneering insight into the study of the format and termed it as 'genre convention' or IMRD sections. Examples from Medical research articles written by non-native users of English have also been cited to substantiate the findings.

The aforesaid formatting pattern (IMRD) is a recurrent phenomenon in scientific research articles and its frequent occurrence is based on its conceptual framework. The conceptual framework of scientific research articles in its wider connotation means the occurrence and arrangement of ideas which are essentially supplemented by reason, experiment and objective interpretation. Hence the IMRD sections are indispensable to maintain objectivity and experimental validity. On the contrary to this, indispensability of objectivity has always been in lesser degree where subjectivity is a prime goal. Therefore in literary and creative writing the essence lies not in objectivity but in writers' deep thinking, observation and

their individual perception. Literary and creative writing is not based on experiemntal assessment. Hence IMRD pattern is not essentially followed in literary and creative writing.

4.1.1 Introduction:

From rhetorical viewpoint the Introduction Section encapsulates background information with special reference to the established knowledge and to the research problems in the field. It explains principles and concepts in the research being popularized and makes claims about the findings from previous researches. In addition to this, the purpose of research and its main procedures are also taken into account. An example of a typical discourse function that makes reference to the established knowledge is given below:

The predatory nematodes process different mechanism to overpower their prey and to feed upon them. They also have characteristics hereditary or acquired to defend themselves from predation.

With the use of Simple Present in the text above the author claims the information to be correct for the past as well as for the future. That is, he is claiming the information in the supporting data to be some sort of

universal truth about the subject. Thus the universality of the notion is asserted in its entirety. The ‘characteristics of nematodes’ in the text above have been made timeless and non-temporal by the use of Simple Present Tense. Hence the ‘predatory nematodes’ perpetually possess such mechanism which help them overpower their prey.

In the Introduction Section reference is also made to the main area of research by explicit prefacing and preparatory expressions which also fall within the ambit of Present Tense and signal the information from the context occurring later in the text. e.g.

The present experiments are conducted to determine the degree of resistance and susceptibility of prey nematodes to predation.³

In the text above, the expression *the present experiments are conducted* is acting as a prefacing or preparatory statement which indicates the direction of discourse that has to be taken up later in the text. The writer has used preparatory expression to stir readers' immediate response to the theme that has to be discussed at length later in the text. Hence on the one hand the author is apprising the readers of his major concern and

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³ Ibid; P. 270
on the other hand he is preparing their minds for his research finding. Reference is also made to the previous research in the Introduction Section which contributes to the development of new experimental research. The findings of the past research are quoted to support the present research. Thus the cited work is brought into close proximity with one’s own work. The aim is to indicate that the ongoing research has developed from a lively tradition of established work in the field. The reference to the previous research is realized in the following ways:

a) by placing author’s name in the subject position

   *E.g.*

   Esser (1963) provided a list of resistant or susceptible prey nematodes to predation by different mononchs and dorylains.⁴

   Two important points are worth noting in the above text. First the text has opened with the citation of a scientist, *Esser* whose previous findings are supplementing the present ongoing research. Thus the validity of the present research has been fully strengthened by making reference to previous research.

   Secondly the use of Simple Past Tense ‘provided’ refers to a single research event. Thus the author wished

   ⁴. Ibid; P.271
to claim no generality for the facts given in support of a core idea. It can be inferred hence that the reference to a specific event, action or process that have occurred during the experiment can only be made in the Past Tense.

b) by making generalized reference to previous research e.g.

*Several workers* have supported the genotoxic and carcinogenic effect of certain steroids and their derivatives.\(^5\)

In the text above, the author has used generalized reference such as 'several workers' which points out to the fact that the area of present research has already been touched upon at length. Instead of referring to any specific finding of a particular scientist, here a vague reference has been made. Secondly the finding has become so common that it has been attempted by several scientists. So nothing is expected to be discovered by present research. Nonetheless it can be taken up as an endorsing attempt.

The information contained in Introduction Section can be didactic and anecdotal presenting sequential account of events. Here is an example of Introduction

which can be said to be performing a didactic function:

Recurrent spontaneous abortion has been treated by means of Immunization with paternal cells and cell from multiple unrelated donors. Organ allograft rejection is diminished by previous immunization with blood transfusion.6

In the above text though the information about the treatment of spontaneous abortion is given in Present Perfect Tense, yet it is perceptive because there is inherent in it an advice for the effective treatment of spontaneous abortion.

Anecdotal information is characterized by the use of prepositional phrases and temporal adverbials such as:

In Britain 150 women are affected by toxaemia.7

When a woman has her first baby she runs a much greater risk of toxaemia than in subsequent pregnancies.8

7. Ibid; P. 86
8. Ibid; P.88
4.1.2 Method Section

The method section of a scientific research article is a highly abstracted reformulation of final outcome. It is essentially a listing of procedural formulae, and a single description of the process which leads to the obtaining of data. It is an elliptical checklist which offers the step-by-step description of what was done in the laboratory. It also describes experimental procedures by identifying main research apparatus, experimental process and criteria for success. Textual examples are given below for its further illustration.

(a) Method Section Including sample size:

Thirty laboratory-based white rats weighing 90 + 5g, were used. They were divided into 3 batches. Batch I consisted of 10 rats and served as untreated control, batches 2 and three comprised 15 and 5 rats respectively and served as test batches.⁹

(b) Method Section indicating source and technique of data e.g.

Esterase and Succinate dehydrogenase were localized by indoxyl acetate and Nitro-BT

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methods, respectively, as modified by Pears (1960). Cobalt-formazan technique was employed for the localization of a glycerophosphate dehydrogenase and glutamate dehydrogenase.¹⁰

The information in the Method Section tends to be realized by the use of Passive Voice. Method Section is also concerned with a discussion of all aspects of the process of data identification and presents in a logical and sequential manner the steps and procedures adopted during experimentation.

4.1.3 Result Section

It is concerned with stating overall observation made in the study and presents information on visuals such as tables, graphs and pictorials. It also gives an account of necessary procedural adjustment made before consistency was achieved in the observation recorded.

The overall observations in Result Section are realized by the following grammatical elements-the passive form or present tense forms which are used to refer to visuals e.g.

1. Measurement of different organs in first, second and third stage larvae are given in table¹¹

¹⁰. Ibid; P. 43.
2. The average concentration of organochlorine and organophosphorus pesticides *are shown* in table 2.12

3. Table 1 *presents* the results of varying doses of infective stage larvae.13

4. Table 1-2 *presents* the quantitative estimation of various biochemical constituent of setaria Cervi recovered from normal control rats.14

4.1.4 Discussion Section:

It restricts the main observations made in the study and indicates their significance, interprets and justifies them by making reference to procedures adopted in the study. The observations may also be contrasted with similar ones made in related studies. In addition to this, Discussion Section also indicates the limitation of outcomes. Such as:

(1) *A little information* is available concerning the effect of host’s sex.

hormones on the metabolism of the parasites.\textsuperscript{15}

(2) However there is no evidence of classification and fabrosis of the worms and tissues in the present experiment as earlier observed by Bertram (1966).\textsuperscript{16}

The researchers have also used hedging device to account for observation made such as:

1) The ecto-parasitic nematodes \textit{seem to be more} vulnerable to predation specially by mononchs.\textsuperscript{17}

2) The impression \textit{appears} to be misleading.\textsuperscript{18}

4.1.5 Co-authorship

One more distinct feature that needs to be mentioned about scientific research articles is that co-authored article publication is a common phenomenon in scientific writing. It appears to be a collaborative enterprise. The researchers interact with peers to confirm their experimental outcomes.

\begin{itemize}
\item \textsuperscript{15} Khatoon, H. (1986). Relationship Between Host sex Hormones and Metabolic Activity of the worm, Helminthologia, 23 (03), 85
\item \textsuperscript{16} Jamil, A (1985). Histopathological Study of Diplostriaena Tricuspis infection in Pigeons; Acta parasitologia Polonica, 30 (4), 32
\item \textsuperscript{17} Shamim, A. (1990). The Vulnerability of Ecto-parasitic Nematodes to Predation Fundam APPL Nematol; 14 (2), 25
\item \textsuperscript{18} Ibid; P. 27.
\end{itemize}
Besides, the dissertation supervisor has tremendous impact on the selection of the topic as well as on the writing of the literature review. The researcher not only needs assistance and guidance of his supervisor in designing and carrying out his research but also needs his invaluable supervision in the presentation of his research finding in an acceptable standard of English.

4.2 Problems With Non-Native Users of Scientific English

The native users of scientific English have an appropriate degree of competence in communicating their findings. They have an innate ability to function in a fairly wide range of contexts, because they acquire naturally the grammatical accuracy, syntactic and semantic appropriacy and deep sense of using well suited terminologies. They express their experiments as clearly as possible because the language they use bear no grammatical error. Since the very childhood they have been well exposed to the language so they know well how and where to use what words, and phrases. On the contrary, the non-native users of scientific language make substantial variation in the use of scientific language. Those who have obtained the mastery of English language can communicate well. They make no mistake. The scientists who are inadequate in English language lack grammatical, semantic and syntactic competence and, hence,
make several mistakes at different linguistic levels. The language used by such novice non-native users of English are full of numerous pitfalls. Hence the mistakes that have been detected at various levels are given below:

4.2.1 Excessive use of Abbreviation and Footnotes

Many well written scientific papers by non-native users of English are marred by being overloaded with abbreviation, so the language they use to disseminate their findings worldwide becomes unintelligible even to the specialists. The problem is that these abbreviations have no prior reference so it has become difficult for the readers to decipher their meanings. Many such examples are cited below:

I. We added DTNB to the TCA prepititated RNA before determining the BUN\textsuperscript{19}

II. Recovery of viability required RNA and protein synthesis, whereas recovery of UV resistance did not.\textsuperscript{20}

III. A similar region from sequences IND. P1745, 1923, was compared to sequence


\textsuperscript{20} Ibid; P.37.
belonging to subtypes F (B10561, RM 14018
and CA13.\textsuperscript{21}

To overcome this problem the writer should use abbreviations sparingly as substitutes only for the terms that have to appear very often in the paper. The writers should make sure that the abbreviations used are widely known and acceptable.

4.2.2 Faulty Parallelism

Using parallelism means to use similar structure for similar elements. The non-native users of English are less competent in using parallel structure for coordinate-elements which have equal value in a sentence. Examples are given below:

I.He brought us to a place where there was not any laboratory nor scientific equipment\textsuperscript{22}

Corrected form: He brought us to a place where there was neither any laboratory nor any scientific equipment.

II. It is generally believed that the research facilities of advanced countries are better than the developing countries\textsuperscript{23}

**Correct**: It is generally believed that the research facilities of advanced countries are better than those of the developing countries.

III. The lifting force of hydrogen is greater than helium

**Correct**: The lifting force of hydrogen is greater than that of helium.

IV. Electronic amplifiers are based either on the electronic value or the transistor

**Correct**: Electronic amplifiers are based either on the electronic value or on the transistor.

### 4.2.3 Problems with Verbs

The non-native users of English who are not well versed in putting forth their exploration commit mistakes in making proper agreement between subject and predicate. For them, language seems to be a secondary thing. The main focus is laid only on the experiment but how to communicate the experiment is often neglected. As a result of this, the sentences they use lack proper agreement between subjects and predicates such as:

23. Ibid; P.26
The enzyme activity of the pollinaccous extracts from mature plants were higher than expected.\textsuperscript{26}

In this sentence the agreement between subject and predicate is not proper. Instead of using "were" higher' the author should have used 'was higher' because the subject of the sentence is activity nor extracts or plants.

Some bacteria causes disease and decay.\textsuperscript{27}

The word 'bacteria' is plural form, so instead of using the verb 'causes' the author should have used 'cause.' The singular form of bacteria is bacterium. This word is confusing for those scientists who are less meticulous in using words and phrases.

Validity of data is the first criteria for the acceptance of any scientific finding.\textsuperscript{28}

Instead of using the noun 'criteria,' the author should have used 'criterion' because criterion is the singular form which corresponds with the singular auxiliary verb.

The mice was decapitated and their diaphragms stretched.\textsuperscript{29}

\begin{itemize}
\item \textsuperscript{26} Khatoon, Humaira, (1984). Effect on the Enzymic Activity of the Pollinaccous Extracts, Indian J. Anim Science. 56(10), 973.
\item \textsuperscript{27} Musarrat, Javed. (1997). Damage and Mutagenesis of Bacteriophage lambda Induced by High PH. Current Science. 65(2), 12.
\item \textsuperscript{28} Bhatnagar, V.N. (1999). Current Advances in Science, Current Science. 66 (1), 12.
\end{itemize}
Here 'the mice were decapitated' is correct because 'mice' is plural form which must have plural auxiliary.

### 4.2.4 Dangling Participles:

The use of participles should be avoided as much as possible when the things are written in third person otherwise confusions are most likely to arise. Errors have also been found in the use of dangling participles. Hence it appears that human actions have been attributed to inanimate objects such as:

Examining the results the conclusions are obvious.

If the sentence is taken at its grammatical face value it will mean that the conclusions are examining the results. The participle phrase 'examining the results' is grammatically unattached because it appears quite absurd to belong to the subject. So the sentence may be corrected by substituting an active verb for the participle, such as:

When we examined the results the conclusions were obvious:

Gerunds have exactly the same form as the present participle in English because a gerund is a noun, it can

30. *Ibid*; P 93
unlike the present participle be the subject of a sentence e.g.:

Acquiring this instrument proved difficult.\textsuperscript{31}

The above sentence is correct but the sentence Before acquiring the instrument the rats were housed in the constant temperature chamber\textsuperscript{32} is not correct because the sentence implies that the rats acquired the instrument.

4.2.5 Dangling infinitives

Dangling infinitives are just as dangerous as participles because the unstated understood subject of an infinitive may not be the subject of the next clause e.g.

To apply this form of treatment the patient had to be admitted to hospital\textsuperscript{33}

The above sentence is wrong because ‘patient’ is not the subject of ‘apply’. This fault may be corrected by substituting the true subject such as:

To apply this form of treatment we had to admit the patient to hospital

4.2.6 Overuse of Noun Clusters

Overuse of noun clusters or abstract nouns impede

\textsuperscript{31} Ibid.\textsuperscript{P.86}
\textsuperscript{32} Ibid.\textsuperscript{P.95}
the easy grasp of the text. Some scientists have mania for using abstract nouns or noun clusters. This is often mistakenly regarded as a model of objectivity and detachment. Good English stylists detest this habit where as non-native users of English make excessive use of noun-clusters which become sometimes difficult to understand such as:

1. Allowing individual input variance of data process entry will result in higher morale in the keyboards.\(^{34}\)

Revised: We will have higher morale if we allow the keyboards to enter data at their own rates.

II. Adult sheep muscle protein iron\(^{35}\) is difficult to understand at one go, so the sentence should be broken up by inserting verbs and prepositions such as: Protein iron that is found in the muscle issue of the adult sheep.

English is flexible in allowing nouns to be used to modify other nouns. Protein iron, for instance, is a short way of referring to the iron bound to or contained in proteins. The trouble begins when perhaps in a laudable effort to be brief the writer puts together a string of nouns,


each of which modifies one of the others. This has been discussed at length in chapter 5.6.2

4.2.7 Problems of Incoherence in Scientific Research

Articles by Non-Native Users of English

Incoherence is a recurring problem for those scientists who are not proficient in English. They display lack of competence in formulating a cohesive text. Many amateur Indian scientists who are less exposed to English produce incoherent texts. Because they can’t acquire innately a high degree of accuracy in the use of cohesive devices at various levels. They do not know well how to make sentences well knitted and how to develop implicit as well as explicit cohesion at various levels. In fact their inadequacy in developing coherence impede the understanding of the text, because clarity of the text is affected by inappropriate use of connectives. It will be appropriate to, briefly, define, first, the coherence and cohesion and then to pinpoint the errors that the novice Indian writers of science make while producing the text. By cohesion Halliday\textsuperscript{36} (1976) refers to the formal surface- syntactic and semantic signals which link sentences within a text. By coherence he means the underlying relation between propositions. Coherence can be


4.2.8 Text-Based Coherence:

Whatever assertion is made in a paragraph should be related to all other elements. This simply means that each idea of the paragraph must be related to the main idea (topic sentence). Secondly to put the main idea first is a key principle for writing sentences which are easier to understand. In addition to this there should exist an underlying thread weaving all the points to the entire article. The findings should be presented in a logical sequence from the beginning till the end of the article. The text becomes difficult to understand if the aforementioned points are not followed by the writer such as:

A heaving line which is a coiled line or rope; a heaving Jug which is a plastic container such as milk or bleach bottle with a half inch of water in it to give it buoyancy and a line or rope connected to it; and a ring buoy and line are three pieces of equipment used to tow victims to share.

The above text ceases to be coherent owing to several factors that are given below:

I. The main idea "three pieces of equipment" has come near the end, so it has become difficult to understand the text at one reading. The readers may be lost while groping for the meaning. The text appears to be a turgid piece of writing because readers may not easily discern where the predicate lies.

II. In addition to this, multiple words and phrases in the text have been punctuated before the occurrence of predicate which further adds confusion to intelligibility. Thus the whole text is marred by the use of a single long sentence. This can be rectified if the main idea is presented first and then let it is followed by further relevant details, development and illustration. More such instances are given below to unravel the errors that the Indian researchers have committed at various levels while synthesizing their scientific findings into a cohesive text.

(i) Secondly electronic media can give direct information and easily reach the consumers. For example, when we watch news on television we can get quick national and international information. [Hence] Hence information in print media is limited. It can give information only
to those who read the newspapers or magazines

Instead of causal relation, the writer should have used an adversative conjunction. Thus, instead of using “Hence information in print media is limited” the writer should have used “however or on the contrary the information in print media is limited.” Secondly the writer’s ineptitude in developing coherence is quite noticeable. The writer puts a contrast between the services of electronic media and print media but incoherence becomes explicit after a close reading of the text. With regard to electronic media the writer describes the quick and rapid availability of national and international information. In contrast to this, the services of print media is not concerned with quick availability of news but the writer says that it caters to those only who go through newspapers.

(II). Firstly it is a waste of time and waste of money when blood is taken from a particular person, the blood sample has to be sent to a laboratory and it needs a couple of days to get the results. The traveller may be only on a week’s vacation and with this interruption the traveller will face difficulties and regret the interruption. [on the other hand] the cost of the

test will not be paid for by the traveller, instead the government will pay for the cost of the test.\textsuperscript{40}

Since the second supporting point in the paragraph "the cost of the test" is adding to the first point a waste of time so a more appropriate transition for the sentence is \textit{In addition} not \textit{on the other hand} as used in the text. The wrong choice of a transitional word disorients the reader though it does not lead to a break down in communication. Thus, the inappropriacy in the use of connectives can be explored by having deep insight into the text.

(III). When people speak of drugs they usually speak on its worst effect rather than its advantages. Usually people know the effect of drugs and try to prevent their families from being drug abused. And it is wise that anti-drug education programmes should begin for children as early as the age of 10 in an effort to prevent drug abuse.

Taking drugs can make people around you, avoid seeing you, your friends will no longer be your friends to chat and laugh with. They will avoid you and declare that you are

not one of their friends. And the worst is when your own family abandons you and finally you are entirely alone in this world. You don’t have friends or even relatives to rely on. It will make your life worse because in our lives we need somebody to rely on.

The two paragraphs that have been mentioned above are loosely connected because the unity of ideas is almost missing. The central idea of the first paragraph is the beginning of educational programmes for children as early as the age of 10. The second paragraph describes the negative effects of drug on people instead of telling the reasons for introducing anti drug programmes for children as early as the age of ten. This deviates from the main objectives set by the author and it does not even support the writer’s own thesis statement that children should know more about drugs and their effects. Numerous effects of drug on men that have been mentioned in the text have no scientific implication but they are simply socially approved. The whole paragraph has been spoiled by excessive repetition of ideas. The major effect that the writer tends to exert is that one is left all alone if one is addicted to drug but so many similar words and

sentences used by the writer to say that much really make the text boring.

IV. After consultation with a design engineer it was concluded that since no alternative was to hand, the existing shaft should be used. Some recommendation can be used in order to reduce the stress in the shaft as much as possible.

A similar problem of connective marker exists in the above paragraph which consists of two sentences but the writer has used no connectives to link two proportionally disconnected sentences. These two sentences can be appropriately linked by the use of concession -connective such as 'here still. Nevertheless, and all the same.

**Error in Anaphoric Expression:**

Errors have also been explored in anaphoric expression. Medical practitioners in their attempt to be more precise deliberately avoid using anaphoric devices which no doubt least hamper the intelligibility but it may render the text incoherent. Such as:

(V). When we feel an emotion certain involuntary changes occur within us. Salivation, breathing

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heart rate, perspiration and muscle tone are very common\textsuperscript{43}

The above two sentences must be linked together by anaphoric device. The referring expression "these" will be a better choice. Hence the sentence should read "These include changes in salivation, breathing, perspiration and muscle tone.

4.2.9 Reader-Based Coherence:

This aspect of coherence is based on the reader's understanding of the text on account of his pragmatic knowledge and his extensive reading. The writer assumes that the reader must know such relevant information. Such implicit assumption creates confusion instead of making the text sufficiently clear. An example is given below in which the scientist has expected the readers to know that Albert Einstein was a genius. The readers who are not well read will find it difficult to identify Einstein with gentle genius such as:

Blame it on Albert Einstein in the very act of freeing us from the straight jacket of Newtonian physics, he slammed the door on our planetary prison. It is life sentence that the gentle genius

imposed on us with no parole\textsuperscript{44}

The adjectival phrase ‘gentle genius’ may be unintelligible to the non specialists. They are less likely to know much about Newton and Albert Einstein, so they can not easily explore whom the gentle genius refers to.

\subsection*{4.2.10 Mistakes in the Use of Active Verbs With Inanimate Subjects}

With regard to the use of active and passive voice, it is also useful to note that the occurrence of active verbs with those inanimate subjects which have inherent function to perform, is a prevalent phenomenon in scientific writing. However the novice-non-native writers find it unacceptably anthropomorphic so they commit gross mistakes on such occasion. Such as

(1) A measurement of the temperature is made with thermometer \textsuperscript{45}

(2) We make a measurement of temperature with thermometer

These sentences are considered to be wordy, hence do not correspond to the scientific mode of writing. Secondly a thermometer has certain function to perform so the active verb will be immensely preferable. e.g. (i)

A thermometer measures temperature. In this sentence the use of active voice is a clear pointer to the function of the instrument and to the work it is made for. Similarly the sentence (ii) rust weakened the metal' indicates the inherent corrosive power of rust to destroy the metal. (iii) The computer program provided a rapid solution to the problem. Here, the sentence shows the computer’s innate capability to give quick response to the problems. (iv) The graph shows the statistical data — (v) The theory suggests ---- (vi) The law states —

In the examples above it is obvious that it takes a manpower to use a thermometer, to state a law or to suggest something by means of theory, that is we anthropomorphise these inanimate subjects but in a restricted manner. In contrast to this, the inanimate subjects which don’t possess such inherent function should not be predicated with active verb form such as:

One end of the strip dips into an aqueous solution of solvent.46

The use of active verb form ‘dip’ is not correct because dipping is not the inherent nature of the strip but a human being does the dipping. Hence, instead of active

use, the passive form will be, here, a better choice, e.g. One end of the strip is dipped into an aqueous solution of solvent.

4.3 Choice of Tense and Aspect in Scientific Research Articles by Non-Native Users of Scientific English

The choice of tense and aspect is a stumbling block for the scientists in reporting research findings and research equipments. Correlation between discourse types and predominence of certain tense and aspect have always been a matter of prime concern for the non-native users of scientific English. Such approach to text suggests not only a greater emphasis on the grammatical elements but also on the writers' viewpoints.

On the basis of the analysis of research articles a major criterion for determining tense choice based primarily on temporal factors has already been explored by EST specialists. Their findings also need to be cited because they have substantiated the present study of scientific research articles written by non-native users of English.

Three areas where the non-temporal use of tense occurs regularly in scientific research articles are:
i. When the writer refers to previously published research.

ii. When the writer makes text reference to visual aids.

iii. When he describes apparatus

With regard to the reference to previous research, it is essential to point out that if the writer uses Past Tense in reporting research done previously by himself or by others then the research is of secondary importance to the current work being reported on. If on the other hand, the writer uses Simple Present or Present Perfect Tense then research is of more direct and primary importance to the writer's current work. The use of Present Tense is often preferred when a discussion follows the initial citing of a reference to their own or others' research. The example that Trimble has cited in this regard is given below to further illustrate several function of three tenses as noted above. This can also be considered as a model for making reference to the previous research, e.g.

From these studies Davis (1962) deduced that auroral display was essentially a fixed pattern. In contrast to this, Akosofu and his colleagues (1961-1964) conclude that there is a basic stable system of auroral arcs. The smallest
disturbance is represented by the formation of rays which Akosofu has shown to be waves or folds in their sheet of aurora. On the other hand Elvey (1957) has observed the formation of rayed arcs.\textsuperscript{47}

In the paragraph above the researcher has used Past Tense \textit{deduced} in relation to the year 1962. The Present Tense 'conclude' and the Present Perfect 'has shown to be' have been used with the span of years 1961-1964.

In line with the conclusion given above, the work of Davis is less directly related to the research being reported on than the work of Akosofu and Elvey.

The information about data collection in Result Section is realized by the use of Past Tense. However, when the writers discuss the visual itself and its relationship to the subject at hand, they choose Present Tense. Thus they shift their point of view from themselves to their readers, e.g.

The results which \textit{are shown} in Table V were \textit{achieved} by developing a new computer program. These results indicate that it is no longer necessary to budget at the 7 per cent

\textsuperscript{47} Originally Cited in English for Science and Technology. (1985) OP.Cit P. 126.
rate for repairs\textsuperscript{48}

The above example illustrates the shift in tense accompanying a shift in point of view. The first sentence has a Present Tense verb when referring readers to the visual and then shifts to the Past Tense when telling how the data for visuals were obtained. In the second sentence the writer returns to the Present Tense in telling readers about the visual aids which is the subject matter of the discourse.

With regard to the description of apparatus, it is essential to mention that if the apparatus being described is still functioning as a useful device then the writer uses Present Tense. If, on the other hand, the apparatus being described is no longer in use the writer uses Past Tense. The examples given below illustrate as to when to use Present or Past Tense while describing an apparatus.

\textbf{Apparatus no longer used.}

The test section was constructed of a pure copper cylinder 2\text{Ft} long, 6 in in id and 6.25 in in od. Both ends of the cylinder were \textit{closed} with removable Pyrex glass and plates

¼ in thick, A fluid port was located at each end of the cylinder.\(^{49}\)

**Apparatus frequently used**

The tunnel is a blow down-to-atmosphere facility operating over the mach number range 0.2 to 3.5. Match number in the tunnel is generated by fixed nozzle blocks at supersonic speeds.\(^{50}\)

While describing the temporary apparatus, the writer has used the described piece of apparatus and then broken it apart so that the components could be used for a different experiment at a later date. Since it was a temporary device the writer described it in Past Tense. In the second description, the 'tunnel' is a piece of apparatus considered to be permanent and so is described in Present Tense. If this tunnel is replaced or torn down, description of it then will be in Past Tense.

**4.4. Choice of Lexical Item in Scientific Research Articles**

Lexical and syntactical choice in any written form more particularly in scientific writing cannot be taken apart.


\(^{50}\) Ibid; P. 86.
from considering the writer's attitude to the subject matter. In other words, the choice of words and selection of grammatical device are subject to the writer's viewpoint. The validity that an invaluable research finding commands and the way the writer deals with it affect the language a great deal. Hence tense and aspect are presumed to operate in complete harmony. Aspect which has been defined as an important means to express the speaker's perspective of events, provides a much more appropriate framework for dealing with his viewpoint. In contrast to this tense locates an event on a time line relative to the speaker. It permits him to express an event within a particular time frame. Besides, tense is employed when the sequence of events matters such as in narration. Aspect is employed when the relative significance of events matters. Thus the explanation of tense and aspect proposed here incorporates the grammatical accounts which are carefully winnowed through the writer's aspect. Such as when the writer has an actual situation to report or describe (e.g. reporting past literature or describing an experiment), he chooses an event notion and then expresses it by an appropriate predicate phrase which is well suited to the writer's particular purpose. The following example may serve to illustrate this choice:
A plant to convert cellulose of pine sawdust into fermentable sugar and that into ethye alcohol failed because a sawmill couldn’t sell as much lumber as plans called for and thereby curtailed the alcohol plant’s raw material supply.  

The writer’s choice of a verb phrase ‘failed’ in the example above signifies both the lexical and syntactical aspects and hence it serves as a model for the non-native researchers to follow in communicating their research finding. For the situation to be expressed the writer has chosen a process event notion expressed by the verb ‘failed’ but from lexical viewpoint the use of the verb ‘failed’ is not the only possibility to express the event. Instead the author could have chosen the stative verb phrase ‘not be successful.’ Thus the sentence would have read ‘a plant to convert cellulose- into alcohol was not successful’. but the severity that the writer wants to associate with the situation will not be achieved. So the writer has used the verb ‘failed’ which is clearly a more dynamic choice because it determines in high degree the non-achievement and failing of the event. It also serves the particular aspect that the writer wants to put forth. Thus ‘failed’ has been chosen to allow the expression of

the writer's viewpoint to create the rhetorical effect and to influence lexical choices used to express situation.

Concurrent with the choice of lexical items is the choice of morphological forms. The rhetorical consideration of aspect influences the semantic choice in a sentence and semantic consideration in turn, influences the grammatical choice with which the writer has to get his research finding across. In brief, the choice of a morphological form is not dictated by the time but is determined by the writer's viewpoint. With respect to tensing potential it is useful to note that the failure of the event can be described in Simple Present, Present Perfect and Simple Past Tense, but the shift in the tense marks the expansion and limitation of the occurrence of event. If the sentence occurs in Simple Present it will indicate unlimited duration of an event. This can be seen clearly in a sentence such as "Alcohol plants fail". Here the failing is predicated as a general fact that is coextensive with the alcohol plants. The author in Simple Present Tense claims the information to be correct not only for the past but also for the future. The event notion of proposition "plants [-----] fail" indicates its usual failing. It expresses the writer's viewpoint that is even more general than the viewpoint in the Present Perfect
Tense. The property of failing is coextensive with the subject "plant." The coextensive meaning of this proposition in the Simple Present can be contrasted with the temporary meaning of the same sentence in the progressive sentence. When the sentence is put into progressive, the coextensive property disappears and the sentence concept is expressed as a temporary quality. The use of Simple Past Tense such as "Alcohol plants failed" means that the writer simply wants to note this as a one-time fact. In Simple Past Tense, the author wishes to claim no generality for the facts given in support of a core idea because the event is time-bound. In Present Perfect Active the event notion of proposition expresses the writer's viewpoint different from the viewpoint put forth in Simple Past. Present Perfect Tense has two parts: one part seems to address past event while at the same time the other part gives the perspective that the event also is a generalization that goes beyond a onetime event in the past. In fact it must reach up to the present. The morphological form called Present Perfect can be considered not only a tense but also an aspect. In its tense role, it refers to the event in the past. In its aspect role it is both a perfective and imperfective aspect. It allows expression of a viewpoint that focuses both a closed-off event and on the
phase starting at the end point of the *closed-off* event and reaching up to the speaker’s present time. Thus the function of Present Perfect is to refer to a *closed-off* event in the past while generalizing its content into the writer’s present time. In the Present Perfect example, the event is complete and the failure is a fact, at the same time, the time period immediately following the failure and reaching up to the writer’s present time is predicated. The effect of plant’s failure in some fashion still pertains to the writer’s present time. In the progressive example, the failure is not a fact but is rather unfolding. In Present Perfect the event is closed off but the writer wants to signal continuity and coherence to stress the link to his own research.

4.5 Rhetorical Function of Simple Present Passive in Scientific Research Articles

The passive is different from other forms in the sense that it is usually not considered a ‘tense’ not even in the traditional meaning of the word. There is evidence for considering the passive as an aspect. Viewing the passive as an aspect allows an explanation of its rhetorical function paralleling those given for the traditional tenses. Such an explanation is especially appealing since it allows to treat the passive as a grammatical category that has remarkable
prominence in EST texts in the same manner as other verb morphology. With regard to the rhetorical function of Passive Voice in scientific writing, the following outcomes have been noticed:

1. The Simple Present Passive likewise its Active Voice indicates an established or standard procedure, such as:

   The control enzyme reaction is accomplished through influences of intermediary metabolic cofactors, various inorganic ions and substrates.

   The use of Simple Present Passive is indicative of the fact that the event for its being an established finding has universal acceptance. It does not refer to one time occurrence. Thus the accomplishment of ‘control enzyme reaction’ through cofactor is not time bound but it has extensive implication. On the contrary, the use of Simple Past Passive refers to one time occurrence of event. The implication of Simple Past Passive is confined to the past only such as:

   Protein and glycogen were found to be decreased to 24.6% and 16.8% respectively. In contrast, liquid content of the worms was

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found to be appreciably increased in both the groups.\textsuperscript{53}

Here, the writer has used Simple Past Passive to point out that the decrease of protein and glycogen is a temporary procedural finding. Hence the finding is less likely to last long.

1. There seems to be an ample evidence that the authors tend to use Passive Voice when they intend to refer to their own proposed future works. Several examples of the use of Passive Voice to refer to future works are given below:

i. This \textit{will be} dealt with in a succeeding paper.\textsuperscript{54}

ii. Whether such a situation is stable under perturbations \textit{will be} investigated in part-II.\textsuperscript{55}

iii. In this section we give exact although implicit solutions for those variables in terms of \textit{S}, which are valid in all regions and which \textit{will be} used in future numerical work.\textsuperscript{56}

\textsuperscript{53} Ibid: P.26

\textsuperscript{54} Shahid, Jameel. (1997). A Genetic Analysis of HIV – 1 from India Reveals the Presence of Multiple Variants, Aids. 12 (7), 38.


\textsuperscript{56} Ibid. p. 420..
In addition to this, the passive is used when the author tends to express the following perspectives. The actional passive portrays a state as the result of a preceding action. It portrays simultaneously an event and the state that results from the event.

The technical writers in order to remain objective and impersonal choose passive form because the important idea is not who did something but what was done. The passive verb will be a better choice to describe experimental procedures, chemical process, cause-and-effect relationship and so forth. Many scientists and engineers believe that everything should be written in Passive Voice. They shun Active Voice because they feel it is too strong and does not fit their professional character. Hence the Passive Voice has been found more frequent in scientific research articles, notably in the objective, non-personal style of scientific articles and news items. A corpus of 8 scientific research articles by non-native users of English are drawn from Natural Sciences. (refer to appendix). These scientific research articles have been analyzed statistically in order to determine the frequency of occurrence of Active and Passive Voice in various sections of scientific research articles. The active and passive sentences along with the statistical data are given below.
Use of Active Voice in Abstract

(1) The exposure of exponentially buffer resulted. (2) Mutants also recovered (3) Bacteria regained (4) Recovery of viability required (5) Resistance did not require (6) Fourth stage larvae caused (7) Histological Examination revealed (8) The drug showed 90% (9) The treated worms demonstrated (10) Different species of grasshoppers reared (11) First and second molts occurred (12) The research indicates.

Use of Active Voice in Introduction Section:

(1) Injury to bacteria caused (2) heat treatment induces (3) post treatment incubation leads (4) Bridges et al demonstrated (5) histozoic and coclozoic parasites tend (6) the host’s defence mechanism tries (7) changes may occur (8) This study deals with (9) Duke found (10) Bernberg et al observed (11) the present study reports (12) thick shelled eggs pass through (13) the existing literature reveals (14) most of the works done pertains (15) nematodes also have (16) Esser provided (17) Small and Groatodes described (18) they proposed (19) It resulted (20) most of the pesticides enter (21) the mutagenicity of the original river water has received (22) the present study deals with (23) a vast literature exists.
**Use of Active Voice in Method Section:**

(1) Salt medium contained (2) tryptone broth (RM) contained (3) E.Coli grows (4) antibiotic reduced the viability (5) batch 1 consisted of 10 rats

**Use of Active Voice in Result Section:**

(1) Strains showed recovery (2) loss of viability occurred. (3) Pol a cells did not recover (4) all the strains recovered (5) the Lex mutant failed (6) holding in tryptone broth increased (7) Heated bacteria regained (8) chloramphenicol interfered (9) Table 1 presents (10) The infective larvae migrated (11) They caused (12) adolescent worms started migrating (13) Both the sexes of pigeons accepted (14) Microfilariae appeared (15) The drug showed delirious (16) Treated worms showed (17) Boundary walls of uterus also contained (18) developing embryos decreased (19) dehydrogenase activity decreased (20) developing embryos did not show (21) second stage larvae consisted of (22) glandular esophagus showed (23) larva glandular esophagus became so large (24) crobeloides resulted in (25) encounters with saprophageous nematodes yielded (26) analysis of samples indicated (27) Table 3 shows (28) The water samples exhibited (29) plate declined (30) Table 4 shows (31) The samples showed (32) T 100 also responded
(33) These samples also displayed (34) extracted samples displayed (35) Table 4 clearly indicates (36) TA 97a displayed (37) all mutants invariably exhibited (38) developing embryos showed.

**Use of Active Voice in Discussion Section**

(1) The authors explained (2) These parts of data don’t agree with these results (3) We found that (4) This might explain (5) Other bacteria do not require (6) Chloramphenicol inhibited (7) Viable bacteria suggest (8) The repair of certain heat lesions occurred (9) They attributed (10) We propose (11) Short periods of heat treatment cause (12) the remaining breaks require (13) protein becomes effective (14) Recovery would eventually require (15) tryptone agar brings about (16) The infective stage larvae show (17) They undergo (18) Migrating larvae cause (19) The worms appear (20) Histological examination of the organs reveals (21) Ash 1973 recovered (22) Diplotriaena triscuspis does not cause (23) worms do not show (24) They survive (25) They escape (26) The consequent decreased utilization would eventually lead to (27) The drug affects (28) The drug reduces (29) reduction in these enzymes leads to (30) Breinlia and Dipetalonema mebendazole appears (31) it takes (32) The prey nematodes
scan resist (33) moisture and chemical composition of soil also play (34) nematodes seem to be (35) Esser suggested (36) he observed (37) depending exclusively on chance encounters (38) Rhabaditis seems (39) The abilities of predators govern (40) Their high degree of susceptibility to predation conforms (41) Samples revealed (42) pesticides detected (43) our results indicated (44) Test samples exhibited (45) Sakamoto and Hayatsa also reported (46) We have found (47) It has become obvious (48) Strains responded (49) Organic extract contained (50) Bourbigot et al have demonstrated (51) Workers have also used (52) Test samples pose the risk (53) the presence of pesticides contributes (54) earlier studies have shown (55) Anwar et al have revealed (56) Key and Khatoon et al have reported (57) Von Brand contended (58) the earlier investigations have revealed (59) earlier studies have shown (60) these organs serve (61) Redington et al have studied (62) It indicates.

Use of Passive Voice in Abstract:

(1) Such heated bacteria were held (2) heat damage was repaired (3) the sensitivity of bacteria was enhanced (4) The present study was carried out (5) adult worms were frequently found (6) They were located (7) They were also found (8) The efficacy of mebendazole were tested
(9) The drug was given (10) treated rats were autopsied
(11) Worms recovered were washed (12) Sections of the
unfixed material were incubated. (13) The activity of the
enzymes were compared (14) third stage larvae were found
(15) Infective stage larvae are occupied (16) 140 infective
stage larvae were recovered (17) anguina triticei to
predation was measured (18) longidorus and Partrichodorus
are provided (19) Water samples were collected (20)
Samples were assayed (21) Setaria cervi was demonstrated
(22) dehydrogenase and adenosine were found (23) The
activities of these enzymes were found

Use of Passive Voice in Introduction:

(1) Their subsequent recovery has been studied (2)
The heat injuries have been characterized (3) Recovery is
defined (4) It has been recognized (5) Little is known (6)
Filarial worms were involved (7) Mebendazol has been
reported (8) Thick shelled eggs were deposited (9) They
were swallowed (10) 90% of mynahs were found (11) The
present experiments were conducted (12) The system has
been found (13) Ganga water is used (14) The present study
was conducted (15) an attempt was made (16) The
biological significance has been established (17) The
normal activities of these enzymes have been reported (18)
The chemotherapeutic efficacy of these drugs has been
proved (19) features have been widely employed (20) Setaria cervi has been undertaken.

**Use of Passive Voice in Method Section:**

(1) Solution was sterilized (2) The medium was suspended (3) Bacteria were always plated (4) all dilution were made (5) bacteria were heat treated (6) viable units were suspended (7) They were placed (8) Samples were diluted (9) bacteria suspensions were diluted (10) rifampicin was added (11) The bacteria were washed (12) heated bacteria were compared (13) bacteria were plated (14) plates were exposed (15) radiation and incubation were performed (16) sensitivity was determined (17) bacteria were labelled (18) They were heated (19) They were incubated (20) Samples were removed (21) fractions were collected (22) trichloradioactivity was measured (23) The laboratory bred pigeons were employed (24) They were divided (25) Infective stage larvae were obtained (26) frequent doses were given (27) infected pigeons were sacrificed (28) lungs and heart were removed (29) infected organs were sectioned (30) infected organs were stained (31) Thirty laboratory based rats were used (32) Worms were transplanted (33) rats were divided (34) Mebendazole was given (35) the rats were sacrificed (36) rats were left untreated (37) untreated groups were washed (38) frozen
sections were obtained (39) esterase and dehydrogenase were localized (40) technique was employed (41) sections were immersed (42) the drug was given (43) microfilarial count was recorded (44) Trilophidia and chrotogonus were used (45) all species were reared (46) adult worms were collected (47) eggs were collected (48) suspensions of eggs were mixed (49) species were starved (50) infected grasshoppers were dissected (51) all developmental stages were studied (52) some larvae were cleaned (53) The predacious nematodes were cultured (54) Anguina and Heterodera mothi were used (55) The three predators were also used (56) nematodes were isolated (57) H mothi and tritici were obtained (58) fifty encounters were observed (59) a prey nematode was placed (60) those observations were recorded (61) prey individuals were used (62) degree of prey resistance and susceptibility to predation were determined (63) all species of predations were tested (64) water samples were collected (65) Narora is located (66) samples were collected (67) a sample of 16 to 20 litres of river water was collected (68) water samples were filtered (69) the absorption was carried out (70) XAD-4 and XAD-8 were obtained (71) organic material was eluted (72) This eluate was evaporated (73) These samples were filtersterilized (74) testing was completed (75) pesticides were extracted (76) water samples were shaken (77) 50ml
chloroform was added (78) chloroform extract was collected (79) organic phase was evaporated (80) these samples were filtered (81) pesticides were filtered (82) pesticides were obtained (83) pesticides were prepared (84) these samples were filtered (85) the extracts were analyzed (86) the material was chromatographed (87) samples were injected (88) retention times were measured (89) characteristics are listed (90) each strain was tested (91) bacterial strains were obtained (92) Sq fraction was prepared (93) Sq mix was freshly prepared (94) the preincubation test was performed (95) five doses of each water extract were pelleted (96) the mixture was vortexed (97) soft agar was added (98) the mixture was plated (99) the plates were incubated (100) homogenetic mix per plate was added (101) serving as the positive control was also run (102) strains were harvested (103) the pellets were suspended (104) samples were withdrawn (105) plates were incubated (106) Twenty laboratory bred rats were used (107) Live Setaria cervi worms were transplanted (108) the infected rats were divided (109) groups I, II and III were treated (110) Levamisole and tetramisole were given (111) four groups were autopsied (112) treated and untreated worms were fixed (113) five laboratory bred rats were used (114) transplant of the setarid worms was made (115) thick blood films were made.
Use of Passive Voice in Result Section

(1) The survival of bacteria is shown (2) The viability of Pal was not affected (3) the bacteria were heated (4) Colony forming ability was assayed (5) the viability of unheated bacteria was also assayed (6) Recovery was influenced (7) bacteria were not shaken (8) the same results were obtained (9) the present strain was heated (10) half of the culture was exposed (11) colony forming units were counted (12) the other half was suspended (13) parallel controls of unheated bacteria were also carried out (14) the initial counts were normalized (15) results were calculated (16) DNA degradation was significantly inhibited (17) Worms were found (18) certain worms were also found (19) good recovery rate was found (20) pathological lesions and intense cellular response were noted (21) live worms were recovered (22) activity was localized (23) a notable reduction was noted (24) drug treatment was observed (25) activity was normally localized (26) partial activity was also noted (27) three stages were observed (28) third stage was reached (29) infective stage was noted (30) third stage larvae were given (31) plug was removed (32) the oral opening was surrounded (33) the esophagus was observed (34) rectum was composed (35) the pair of amphids was observed
the oral opening was surrounded (37) 140 infective larvae were recovered (38) 33% of them were left unconsumed (39) the pesticides were extracted (40) the concentrated extract was analyzed (41) pesticides were detected (42) declining trend was also observed (43) the strains could be suspended (44) the mutagenic activity was enhanced (45) these strains could be listed (46) the damage brought was found to be high (47) the lex A mutant was found (48) all the drugs were found (49) tetramisole and levamisole were found (50) activity was noted (51)

Appreciable decrease was noticed (52) no change was noted (53) activity was localized (54) the enzyme activity was reduced (55) ATPase activity was found (56) the activity of this enzyme was found (57) enzymatic activities are given (58) activity was noted (59) aldolase activity was mainly localized (60) Malicdehydrogenase activity was noted.

Use of Passive Voice in Discussion

(1) deficient strain was later shown (2) survival was enhanced (3) heated bacteria were held (4) E.coli in MM is well documented (5) recovery of viability was inhibited (6) tolerance was regained (7) other prey speceis were left (8) slides were washed (9) synthesis of repair enzymes was
not required (10) lesions are repaired (11) recovery was obtained (12) a similar result reported (13) recovery was obtained (14) these specific regions are attacked (15) similar observations have been made (16) worms are restricted (17) worms were found embedded (18) similar observations have been reported (19) it may be included (20) the drug has been reported (21) third stage larvae are seen (22) ability of predator was considered (23) thornei may be attributed (24) the same has been observed (25) analytical methods have been extensively used (26) the agricultural run off is expected (27) Water samples were extracted (28) half of them were found (29) concentrated water was found (30) active anthelmintic compounds have been reported (31) glycogen synthesis and glucose uptake are decreased (32) examined enzymes have been found (33) similar line of reasoning can be employed (34) enzyme patterns and their function have been studied (35) active glycogen synthesis and uptake have been demonstrated (36) RNA staining was found (37) strong activity was observed (38) Aldolase is believed.

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<thead>
<tr>
<th></th>
<th>Active Voice</th>
<th>Passive Voice</th>
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<tr>
<td>Abstract</td>
<td>12 (3.1%)</td>
<td>23 (5.7%)</td>
</tr>
<tr>
<td>Introduction</td>
<td>23 (5.7%)</td>
<td>20 (5%)</td>
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<tr>
<td>Method</td>
<td>05 (1.1%)</td>
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The present statistical finding is a clear pointer to the predominant occurrence of passive verbs in scientific research articles. The most conspicuous increase in the use of Passive Voice is seen to occur in Method Section. In this section the frequency of Passive Verb has gone up to 115(29%). The overall ratio of Active Voice is only 140 (35.3%) where as the over all ratio of Passive Voice is 256(64.6%) of the total number of running Verbs.

In addition, the preponderance of passive form in Method Section reflects the tendency of the writers to detail the procedural formula offering the step-by-step residual description of what was done in the laboratory.

4.6. Use of Questions in Scientific Research Articles by Non-Native Users of English

4.6.1 Since the scientists happen to face strong opposition while communicating their findings so they use different devices to fight for their ideas as well as to get their works published. Thus the scientists are bound to have recourse to various rhetorical devices in an attempt to persuade their readers. Most prominent and useful among them is "interrogative gambit" which is a typical device used in scientific Journals to popularize facts and findings.
The use of questions in the organization of discourse is a very strong rhetorical device because it enables the writer to catch the readers' quick response and to make up their minds for the follow-up. They are used to arouse the reader's interest as discourse organizers, or as attitudinal markers. They are also used to express doubt and caution.

It has been found that questions are frequently used in the titles of scientific articles in order to draw attention, to rouse interest and to pinpoint the main topic of the paper. An example of such type is given below:

Are some animals more equal than others?\textsuperscript{57}

The writer has drawn this famous quotation from George Orwell's \textit{Animal Farm} and used it as the title of his article to discuss the merits of porcine versus human insuline. This is one of the most controversial issue in diahectology in recent years. This title increases the reader's curiosity and stir his deep thinking on the subject. In some headings, the verbs are not put in interrogative form but the writer puts simply a question mark to introduce a note of doubt such as:

Farce on wrong flows?\textsuperscript{58}

\textsuperscript{58} Parsad, M.K. (1996) 'Farce on Wrong Flows' Down to Earth, 5 (14), 23.
For a safer landing?

Frayed and facilities?

Cooling interference?

4.6.2 Interrogatives are frequently used when the author tends to provide framework for the discourse. The author will pose question or a series of questions in the first paragraph and the rest of the article will consist of the author’s own answer to the questions asked at the beginning. This again is to arouse the reader’s interest and to create anticipation. A series of questions that are put forth in the beginning introduce the main aspects of the problems to be addressed in the text. This is a good technique to start the communication with question in order to draw the reader’s full response.

The use of question also serves the readers to move from old to new information and it calls to the readers’ mind the information they already possess and prepare them for what is to follow. A simple example of this technique is given below:

How are the scientists to face the challenge?

The rest of the article is basically a series of

59. Ibid; P. 26
60. Ibid; P.38
61. Ibid; P.40
62. Ibid; Vol.6, No.14 P.20
suggested answers to this question which represents the author's standpoint. This is a good example of this discourse technique.

There are also examples where the writer poses a question at the outset which later on is followed by interpretation and details such as:

"Why should we bother to draw attention to the manufacturing of sophisticated weapons?"\(^{63}\)

Here the question is followed by details and multiple suggested opinions.

Interrogative forms are also used when the writer is addressing a highly complex subject. In this case no explicit answers are given. The issue is considered open to debate. The questions are usually spread throughout the text in this case. The examples are given below:

i Who has the right to know of an individual's genetic make up? and what use may be made of this knowledge?

ii Can employers and insurance companies demand its disclosure as a condition of employment or the insurance?

iii Should we add laws against discrimination on the grounds of genetic make up to these against discrimination on the grounds of race, religion and gender?**64**

In the above sentences the writer has used a series of questions which stir the reader’s mind to think on the several aspects of the subject which is fraught with ethical and scientific problems. Sometimes the rhetorical question is used to indicate provocative note which signifies the author’s attitude, such as:

If mothers have the right to bear children with aids, why can they not choose to have a genetic defect connected and so to pass it on to their children.**65**

**4.6.3** Sometimes questions are used to point to the future with suggestion for debate or future research or as a kind of punch line to end the article. Such example has been found in an editorial from ‘The Lancet.” Here the question has been used in the last paragraph. After a discussion covering three paragraphs the final paragraph starts.

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The mechanism of HSV latency remains an enigma.\(^{66}\)

The sentence stresses the obscurity of the subject which is followed by four questions which end the article.

i. "Is there transcription as yet undetected at an extremely low level from the HSV genome?"

ii. "What is the role, if any, of the cell genome in the control of latency?"

iii. "Are there cellular sequences analogous to the latency associated transcripts?"

iv. "Which as the writer notes, are critical questions.\(^{67}\)"

These questions indicate gaps in present knowledge and represent an appeal to continue research in the field. This is a way of appealing directly to the reader in a genre where direct second person statements are extremely rare. There is no answer provided and thus the whole subject is left open. It leaves the reader with a handful of future issues and unresolved problem to ponder on. Finally there are rhetorical questions which are provocative because

\(^{66}\) Ibid; P. 24

\(^{67}\) Ibid; P. 25
they are used to attack or criticise other authors or theories as in the last sentence of an article.

What would Darwin have said about human race?⁶⁸

This is also a way of expressing disagreement and mockery. Another example in the same context is as follows:

Has he taken leave of his senses?⁶⁹

To sum up, the use of questions in scientific texts creates anticipation, arouses interest, and challenges the reader into thinking about the topic of the text. Questions have a direct appeal in bringing the second person into a kind of dialogue with the writer which other rhetorical devices do not have to the same extent. At times they may be discrete. At other times they may be very aggressive when they are used to attack opponents as part of academic debate. They are also used to make mockery and sarcasm as intended by the writer on persons or things deserve to be detested.

4.7 Use of Hedges in Scientific Research Articles by Non-Native Users of English

Hedging, the expression of tentativeness and

⁶⁸. Ibid; P. 26
⁶⁹. Ibid; P. 27
possibility by means of epistemic device, is often held to be an important feature of scientific discourse based on specialist-to-specialist research articles as well as on less specialized texts meant for less scientific discourse community. In both types of scientific articles, hedging can be applied to increase conceptual fuzziness when information such as exact reference or precise numerical is unobtainable or unnecessary in view of the needs of the audience. Therefore, a relatively low degree of exactitude partly accounts for the occurrence of hedging devices. For example, by using the epistemic modal auxiliaries, tentative reporting verbs, tentative nouns and the like. In addition, scientist also can signal to the readers that what is said should not be perceived as the only possible interpretation. Thus hedging can be regarded as the textual study that scientists can use to adjust their accounts of scientific activities to their readers because it modifies the information put forth to suit the needs of the assumed non-specialist audience. As a matter of fact a scientist must present himself as a sincere student of discipline while asserting his individual contribution. He has to be cautious in how he defines
his relationship to a specialist or a layman, and the use of hedges to express ideas is a crucial means of achieving a close fit between his statement and consensus of readers. More particularly in popular scientific writing hedging is an integral part of both supporting the writer's position and building writer-reader relationship, because it allows claim to be made with due caution, modesty and humility. Hence today's scientists are urged to use a style of writing which projects both personal modesty and honesty. In fact, they are well aware of the fact that argumental arrogance and exuberance are not well regarded by the scientific community. Salager (1994) is also of the same view when he says:

When a scientist goes to the heart of the matter, he is open to attack. As a consequence everything must be toned down; speculation can obviously be made but it must be apologized for.\(^{70}\)

In order to reach this goal a scientist has variety of linguistic devices available which generally go under the rubric of hedges. The taxonomy of hedges as identified linguistically is as follows:

I Epistemic Main verbs such as 'to indicate, to suggest', to propose, 'to tend', to seem, to appear etc.

II Epistemic Modal Auxiliaries such as may, might, can, could etc.

III Epistemic Adjectives such as hypothetical, probable, likely, etc.

IV Epistemic Adverbs such as presumably, perhaps, probably etc.

The most frequently used hedging device in scientific English falls into the categories mentioned above. They are used in scientific English to tone down and enhance quantitative and qualitative information as well as to modulate the degree of certainty on the author's part. Textual examples drawn from research papers written by non-native users of English in Medical Sciences are given below to further elucidate several epistemic divisions and functions of hedges.

4.7.1 Epistemic Main verbs

The epistemic main verbs which constitute a typical way of expressing possibility consist of two categories. The first category consists of epistemic reporting verbs such as 'to indicate, to suggest, to propose and to suspect. The second group includes three intransitive verbs
(appear, tend, seem) often referred to as semi auxiliaries. The first category contains verbs which characteristically occur as markers of tentativeness in reports of the author's own or other researchers' work used as predicates in sentences where the subject is either a scientist or in many cases an inanimate noun e.g.

i Earlier studies *indicate* a cell cycle dependent effect.\(^7\)

ii The previous researchers *suggest* that the worms living in the host body whether alive or dead appear to release certain metabolites.\(^7\)

iii Post *proposed* that manic-depressive illness progresses in a similar fashion, each episode facilitating the next one.\(^7\)

iv Nevertheless, we and many other *scientists suspect* that cell-mediated rather than antibody-mediated immunity is primarily responsible for the development of insulin-dependent diabetes.\(^7\)

The second group of epistemic main verbs such as ‘appear’, ‘seem’ and ‘tend’ are often referred to as semi-auxiliaries, but in fact, these verbs exhibit many of the same qualities as epistemic reporting verbs in that they can be utilized to express tentativeness when the author’s or another researcher’s ideas and findings are described:

i. The efforts of several laboratories have together yielded at least one technique *that seems* to work well.  

ii. Our study *appears* to confirm the usefulness of oral steroids in the care of patients with asthma after treatment in the emergency room.

iii. In nervous patients, repeated blood pressure estimation *tends* to result in progressively lower figures.

4.7.2 Epistemic Modal Auxiliaries

Among modal auxiliaries, *may, might, can, could* are also occur in scientific research articles written by non-native users of English for expressing tentativeness and possibilities. Such as:

77. Ibid. P. 289.
While particular antibodies may play a crucial role in the pathogenesis of disease.  

Although an H. influenzae type polysaccharide with T-cell-dependent characteristics might be beneficial to HIV-infected adults.  

Infection can involve any organ or system of body and thus embrace all medical disciplines.  

This increase could have profound public health consequences because chancroids may facilitate HIV transmission.

4.7.3 Epistemic Adverbs

Adverbs are another often-mentioned group of epistemic items. Here the focus is on those adverbs that can most clearly be linked to epistemic possibility, namely modal probability adverbs such as 'presumably' perhaps, and probably. Such adverbs indicate the speaker's or

80. Ibid. P.245.
writer’s attitude or approach towards the statements put forth. The following examples present typical cases of these items in hedging:

i Patients improved *presumably* because of a combination of study or learning effects and the residuum of a positive response to tacrine.\(^{82}\)

ii In the absence of randomised trials, these data *probably* provide reliable estimate of outcome for patients treated with observation and delayed hormone therapy.\(^{83}\)

iii *Perhaps* the most persuasive aspect of the postaglandin hypothesis was.\(^{84}\)

4.7.4 Epistemic Adjectives:

Instead of using epistemic adverbs, it is also possible to express tentativeness by means of epistemic adjectives such as *hypothetical, probable, and likely.* These adjectival hedges are often mentioned in the Result Section of scientific research articles when the writer is deducing

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inferences based on his intensive research finding. These adjectives can most readily be associated with epistemic possibility. Three such probability adjectives as mentioned above, indicating different degrees of commitment of the author's part are given below with textual examples.

i. On the basis of work done in several laboratories, however, we can outline a hypothetical sequence consisting of three basic stages, each of which might be amenable to intervention.  

ii. In fact, it seems probable that there were other important differences.

iii. These results suggest that T cells are likely to be the most important part of the initial immune response to thyroid antigen in such patients.

To sum up, examples of epistemic hedges that have been cited above suggest that scientists use epistemic hedges in scientific research articles when they intend to express possibilities, probabilities and tentativeness. This is, in fact, an important device with which scientists develop intimacy with the readers and open the gate for

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the influx of several other findings. The use of hedges in scientific research articles also suggests that they are used when the scientists come up with new findings. However, it is not advisable to use them with well-established formulae.