The Art of Scientific Writing

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DNA pioneer Francis Crick letter sells for $5.3m at New York auction

Crick wrote to his son in 1953 including a sketch of the DNA structure

A letter written by scientist Francis Crick describing his discovery of the double helix shape of DNA has been sold for $5.3m (£3.45m).

An anonymous buyer purchased it at a New York auction on Wednesday.
Recommendations for Researchers
Hyland (2007)

- Considerations
- Reader Types
- Motivate Reader

- Genre Structures
- Useful Frameworks

- Self Mention
- Hedges
- Citation

- Clear
- Accurate
- Concise
Characteristics of Scientific Writing

- 'objective' not 'subjective',
- 'intellectual' not 'emotional',
- 'serious' not 'conversational',
- 'impersonal' not 'personal',
- 'formal' rather than 'colloquial'

Clanchy and Ballard (1992), cited in (Jordan, 1997: 244)
Who?

AUDIENCE
Writing Considerations

**AUDIENCE**
- who?
- level of knowledge

**TONE**
- Style,
- manner of expression,
- grammar,
- vocabulary,
- length of sentences

**PURPOSE**
- persuasive,
- expository
<table>
<thead>
<tr>
<th>Purpose</th>
<th>Document Types</th>
<th>Intended Readers</th>
<th>Linguistic Style</th>
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</thead>
<tbody>
<tr>
<td>Recording and archiving</td>
<td>Laboratory notes, with other preservable forms of documentation, such as equipment, printouts, photos, and special artifacts for verifiability</td>
<td>Self; research collaborators; workplace supervisors</td>
<td>Informal to highly formal notations in arcane shorthand; lab jargon</td>
</tr>
<tr>
<td>Professional exposition and synthesis</td>
<td>Scholarly articles and books; abstracts; notes and visual media for conference papers and seminars; letters; e-mail</td>
<td>Researchers in same or related field</td>
<td>Highly formal, with heavy use of jargon</td>
</tr>
<tr>
<td>Performing job duties</td>
<td>On-the-job communications, including e-mail, letters, memoranda, meeting minutes, and activity or progress reports; internal and external</td>
<td>Research associates, colleagues, and administrators</td>
<td>Informal to highly formal; low to high level of jargon</td>
</tr>
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<tr>
<td>Seeking research resources</td>
<td>Grant proposals to government agencies, corporations, and philanthropic foundations</td>
<td>Granting agency officials; peer reviewers</td>
<td>Highly formal; moderate to heavy use of jargon</td>
</tr>
</tbody>
</table>
”You can understand that we are very excited. We have to have a letter off to Nature in a day or so.

Lots of Love
Daddy”
MOLECULAR STRUCTURE OF NUCLEIC ACIDS

A Structure for Deoxyribose Nucleic Acid

We wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.

A structure for nucleic acid has already been proposed by Pauling and Corey. They kindly made their manuscript available to us in advance of publication. Their model consists of two inter-twined chains, with the phosphates near the fibre axis, and the bases on the outside. In our opinion, this structure is unsatisfactory for two reasons:

1. We believe that the material which gives the X-ray diagrams is the salt, not the free acid. Without the acidic hydrogen atoms it is not clear how forces would hold the structure together, especially as the negatively charged phosphates near the axis will repel each other.

2. Some of the van der Waals distances appear to be too small.

Another three-chain structure has also been suggested by Fischer (in the press). In his model the phosphates are on the outside and the bases on the inside, linked together by hydrogen bonds. This structure, as described, is rather ill-defined, and for this reason we shall not comment on it.

We wish to put forward a radically different structure for the salt of deoxyribose nucleic acid. This structure has two helical chains each coiled round the same axis (see diagram). In view of the usual chemical assumptions, namely, that each chain consists of phosphate diester groups joined by beta-deoxyribofuranosyl residues with 3’-5’ linkages, the two chains (but not their bases) are related by a dyad perpendicular to the fibre axis. Both chains follow right-handed helices, but owing to the dyad the sequences of the atoms in the two chains run in an opposite direction. Each chain loosely resembles Furrer’s model No. 1; that is, the bases are on the inside of the helix and the phosphates on the outside. The configuration of the sugar and the atoms near it is close to Furrer’s ‘standard configuration’, the sugar being roughly perpendicular to the attached base. There

This figure is purine diamonoida. The two chains symbolize the two deoxyribose–phosphate chains, and the vertical axis the fibre axis of the chain.
In other words we think we have found the basic copying mechanism by which life comes from life. The beauty of our model is that the shape of it is such that only these pairs can go together, though they could pair up in other ways if they were floating about freely. You can understand that we are very excited. We have to have a letter off to Nature in a day or so. Read this carefully so that you understand it. When you come home we will show you the model.

Lots of love,

Daddy
Know your Readers

• How much does your audience know about the subject?
• Is the document for a research supervisor, a journal, a public official?
• How should a document’s technical formality and style be adjusted for its reader(s)?
• Do the writer’s intentions match the reader’s expectations?
Hi! I am a scientist working in the same area as you. I may not be doing the exact same research, but I am a regular reader of the journal you read and attend the conferences you attend. I was the guy sitting on the fifth row facing you when you presented your paper in Korea last year. I read most of the abstracts to keep up to date with what’s happening.
Hi! You know me and I know you, although we have never met face to face. We reference each other in our papers. By the way, thanks for the citation. I am trying to find a niche where you are not playing, or maybe I’ll fix some of your problems in my next paper. Hey, who knows, maybe you are onto something I could benefit from. I’d love to chat or work on a common paper one of these days. Interested?
The seeker of a problem to solve

Hi! You don’t know me. I am a senior researcher. I just completed a major project, and I am looking for something new to do. I am not quite familiar with your field, but it looks interesting, and it seems as though I could apply some of my skills and methods to your problems and get better results than you. I am reading your paper to find out.
Help! I’m stuck. My results are average. I am pressured to find a better solution. I need to look at other ways of solving my problem. I started looking outside my own technology field to see if I could get fresh ideas and methods. I’m not too familiar with what you’re doing, but as I was browsing my list of titles, I discovered that you are working in the same application domain as I am.
Hello! I’m fresh out of university, and quite new to this field. Your paper looks like a review paper. That’s exactly what I need right now. Nothing too complicated; just enough for me to understand the field, its problems, and the solutions advocated by researchers. That will do just fine!
Hi! Cute title you’ve got there. I had to read your paper. Such a title could only come from an interesting writer. I thought I would learn a few things, a paradigm shift maybe. I’m not sure that I will understand any of it, but it’s worth a try. Last time I did that, I learned quite a lot. The paper had won the Best Paper Award in an IEEE competition. I studied the paper. Although I did not understand much, I got quite a few hints on how to improve my scientific writing skills!
Meet the goals of your readers to motivate them (Lebrun, 2007)
Recommendations for Researchers
Hyland (2007)

- Reader Types
- Motivate Reader

- Genre Structures
- Useful Frameworks

- Self Mention
- Hedges
- Citation

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- Accurate
- Concise

Audience & Purpose
Structure
Awareness
Language
STRUCTURE?
Scientific Discourse Community
Schematic Structures

Introductions - Swales (1990)
Methods – Peacock (2007)
Results Brett (1994)
Discussion (Lewin et al. 2001)
Abstracts (Hyland, 200/2004)

Research Proposals
MOVES in INTRODUCTION

• **MOVE 1: Establishing a Territory**
  - Claiming Centrality
  - Making Topic Generalizations
  - Reviewing Previous Research
  
  This move can describe the current situation, features and characteristics of that area of study, as well as why it is an important field and who has already been working in it.

• **MOVE 2: Establishing a Niche**
  - Counter-Claiming
  - Indicating a Gap
  - Question-Raising
  - Continuing a Tradition
  
  The most common way of achieving this is to present a *negative evaluation* of some feature of the research "territory" described in **Move 1**. This is often signalled by words expressing a *contrast* or *negative evaluation*.

• **MOVE 3: Occupying the Niche**
  - Outlining Purposes
  - Announcing Present Research
  - Announcing Main Findings
  - Indicating Structure of the Article
  - Evaluation of Findings
  
  Here, the writer states how s/he intends to fill the gap, answer the specific question or continue the research tradition that was described in **Move 2**.
MOVE 1: Establishing a Territory

The effect of... has been studied extensively in recent years. The effects of... have received considerable attention. Many investigators have recently turned to... A large body of data concerning... has been reported. In recent years, there have been many papers describing... Recently, there has been wide interest in... In recent years, researchers have become increasingly interested in... Knowledge of... has great importance for... The study of... has become an important aspect of... The theory that... has led to the hope that... A long-standing problem has been to obtain more information on... A central issue in... is the validity of...

The general features of... are well known. Plumage coloration is known to influence mate selection in mallards. An increase of Mallards in eastern North America has been well documented. Trout are believed to be relatively immobile. It is generally accepted that...

Smith (1989) found a clear relationship between... Smith (1989) argued that... Smith (1989) concluded that... It has been suggested that... (Smith 1989) Data have been presented in the literature which show that... (Smith 1989) Observations by Smith (1989) suggest that...
However, this view is challenged by recent data showing...
However, these studies have failed to recognize the...

A considerable amount of research has been... but little research...
...has been extensively studied. However, less attention has been paid to...
As a result, no comprehensive theory appears to exist.
Despite the importance of..., few researchers have studied...
Research has tended to focus on...rather than...
The only reported study to date of...covered a limited range of...
...studies have appeared previously in the literature, but measurements were restricted to...

These differences need to be analyzed...
Hence, additional studies of...are needed.
MOVE 3: Occupying the Niche – Outlining Purpose

HUMAN AGENT:

In this study, we suggest a 3-step process...
In this letter, we propose a... algorithm.
In this paper, we attempt to develop a...
In this article, we provide a novel approach to...
In this paper, we describe novel algorithms for...
In this paper, we present a system for...
Here, we will analyze the performance of...
In this letter, we present an efficient routing protocol that...

INANIMATE AGENT:

This paper evaluates the effect on...
This paper presents data on...
This study focuses on a strategy for...
The present study tested...
This thesis proposes a formal procedure for...
This paper introduces a novel architecture for...
This research aims to develop a methodology for...
Author as actor:
In Section II, we describe the framework used to...
In Section IV, I present the model used to...

Text as actor:
Section II describes the framework used to...
Section IV presents the model used to...

Content as subject:
In Section II, the framework is described that was used to...
In Section IV, the model is presented...
MOVES

• **MOVE 1: Establishing a Territory**
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  - Reviewing Previous Research

This move can describe the current situation, features and characteristics of that area of study, as well as why it is an important field and who has already been working in it.

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  - Outlining Purposes
  - Announcing Present Research
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  - Indicating Structure of the Article
  - Evaluation of Findings

Here, the writer states how s/he intends to fill the gap, answer the specific question or continue the research tradition that was described in Move 2.
Introduction task

Obesity is the strongest risk factor for knee osteoarthritis (OA), but evidence from cross-sectional surveys for a link between obesity and hand OA is inconsistent. Findings from the longitudinal Tecumseh Community Health Study suggest that adult obesity is associated with incident hand OA in men and women ages 50–74 years. The mechanism underlying the association between increased body weight and OA probably involves mechanical loading across joints.

However, the force across hand joints is not necessarily greater in persons who are overweight, and metabolic factors associated with obesity have been implicated; some of these, such as impaired glucose tolerance, are also linked to low weight at birth. The relationship between OA and body weight in early life is not known. Using prospectively collected data from a large, population-based birth cohort, we examined the relationship between birth weight, childhood growth, adult weight, and hand OA.
LANGUAGE?

Objective
Precise
Clear
OBJECTIVITY & PRECISION
Objectivity: any claims that you make need to be based on facts, not intuition or emotion

Precision: ambiguities in writing cause confusion and may prevent a reader from grasping crucial aspects of the methodology and synthesis
Objectivity: Don’t Fear Pronouns

..... when they are appropriate.
Passives

The story of the passive lover

Imagine yourself at the doorstep of your loved one. You are clutching, somewhat nervously, a beautiful bouquet of fragrant roses behind your back. You ring the doorbell. As your loved one opens the door and gives you a beaming smile, you hand out the bouquet of flowers and utter these immortal words:

“You are loved by me.”

What do you think happens next?
(a) You eat the flowers; or
(b) You ring the doorbell again and say the same thing using the active voice.
Abstract

"The GCB and ABC DLBCL subgroups identified in this data set had significantly different 5-yr survival rates after multiagent chemotherapy (62% vs. 26%; P ≤ 0.0051), in accord with analyses of other DLBCL cohorts. These results demonstrate the ability of this gene expression-based predictor to classify DLBCLs into biologically and clinically distinct subgroups irrespective of the method used to measure gene expression."

Introduction

"We demonstrate that this method is capable of classifying a tumor irrespective of which experimental platform is used to measure gene expression. The GCB and ABC DLBCL subgroups defined by using this predictor have significantly different survival rates after chemotherapy."
Words that indicate a lack of precision in scientific writing

<table>
<thead>
<tr>
<th>Typically</th>
<th>A number of</th>
<th>Several</th>
<th>Many</th>
<th>Most</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally</td>
<td>The majority of</td>
<td>Less</td>
<td>Others</td>
<td>A few</td>
</tr>
<tr>
<td>Commonly</td>
<td>Substantial</td>
<td>Various</td>
<td>More</td>
<td>The main</td>
</tr>
<tr>
<td>Can /May</td>
<td>Probably</td>
<td>frequent</td>
<td>Often</td>
<td></td>
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</tbody>
</table>
Researchers have found that experiments with crops under reduced lighting require a considerable amount of time because the seeds germinate so slowly.

2. Johnson and Brown (2003) have found that experiments with tomatoes and carrots in 50% and 75% light-deprived environments require 12–16 weeks instead of 7–8 weeks because the seeds take twice as long to germinate.
Concepts and methods in the sciences can often be complex; writing that is difficult to follow greatly amplifies the reader’s confusion.
DETACHED PRONOUNS

This, it, they, them and their
Example

The cellular automaton (CA) cell, a natural candidate to model the electrical activity of a cell, is an ideal component to use in the simulation of intercellular communications, such as those occurring between cardiac cells, and to model abnormal asynchronous propagations, such as ectopic beats, initiated and propagated cell-to-cell, regardless of the complexity of THEIR patterns.
Keep these Happily Married Couples Together

| An unfamiliar word and its definition | A verb and its object |
| An acronym and its definition        | Background information and the text it clarifies |
| A noun/phrase and its pronoun        | A visual and its complete caption |
|                                      | A verb and its subject |
Take home message

Minimize the time, memory, and energy needed for reading while keeping your readers' attention and motivation high.
Sources


