Tim Skern

Writing Scientific English

A Workbook

facultas wuv UTB

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> *It is well-known that, in grammatical terms, languages are more perfect the older they are and that they always become gradually worse, from high Sanskrit down to English jargon, this patchwork cloak of thoughts stitched together from rags of heterogeneous material.*
> *(Bekanntlich sind die Sprachen, namentlich in grammatischer Hinsicht, desto vollkommener, je älter sie sind, und werden stufenweise immer schlechter – vom hohen Sanskrit an bis zum englischen Jargon herab, diesem aus Lappen heterogener Stoffe zusammengeflickten Gedankenkleide.)*
> ARTHUR SCHOPENHAUER

The chapter begins by looking at the advantages and disadvantages of English as the language of scientific communication, presents some guidelines on how to write the formal English found in scientific writing and ends by suggesting a basic vocabulary for written scientific communication.

1.1 Advantages and disadvantages of English

English has become today's language of science through historical *events*, not through any inherent characteristics that make it better suited to the task. Fortunately, English does have many positive characteristics that make it suitable for scientific writing. However, some negative ones also make it less than ideal. The positive characteristics include a relatively straightforward grammar and an enormously rich vocabulary; the irregular pronunciation and the inconsistent spelling are two negative ones.

The straightforward grammar makes it relatively simple to construct sentences. The order of words is uncomplicated and there is no need to worry about the gender of nouns or about the appropriate ending of an adjective. Changes in the verb endings are also *limited*. Nevertheless, it is the verbs, with their large number of tenses, that do cause the most difficulty in applying English grammar.

English's richness of vocabulary gives writers a tremendous flexibility in the words they can choose. Where does this wonderful richness of vo-

cabulary originate? One source lies in English's French, German and Scandinavian roots. As a consequence, English often has both a French- and a German-based word for the same thing or concept. The pairs of scientific words "infancy" and "childhood", "judicious" and "wise", "malady" and "sickness" and "transmit" and "send" are just a few examples. A second source of variety in English is the habit of English-speaking people to absorb words from other languages. For instance, the word "robot" originates from the word in many Slav languages for work; in contrast, the words "alcohol" and "elixir" have an Arabic origin. The excellent website www.krysstal.com/borrow.html lists the hundreds of words that English has *assimilated* over the centuries. Schopenhauer was quite *correct* in describing English as a patchwork language.

In his book "Mother Tongue: The English Language", Bill Bryson states that this richness of vocabulary gives English an advantage over many other languages. He proposes that a language with a wider vocabulary has more ways to express the same thought. This may be true, but a wide vocabulary is not necessary to express one's ideas. The writer Ernest Hemingway was famous for using a limited range of words. *Nevertheless*, he was still *able* to articulate powerful emotions and describe profound thoughts.

The two negative characteristics of English mentioned above do, however, place it at a distinct disadvantage compared to other languages. The irregular and often seemingly perverse pronunciation means that even native English speakers will have no idea how to pronounce a word with which they are unfamiliar. How difficult is it then for non-native speakers to learn to pronounce English correctly? How can one explain that the important scientific words "mature" and "nature" are pronounced differently? How could a young person who had lived for a year in Hollywood as a teenager and who spoke English with an excellent American accent mispronounce the words "nitrogen" and "oxygen"? These two gases are not normally words that teenagers frequently use. Without having heard their pronunciation, it is hard to know that they rhyme with Ben and not with bean. This book is, however, only concerned with writing. A discussion on the vagaries of pronunciation can wait for another day.

Spelling is, in contrast, *essential* for accurate scientific writing. It is vital that students are *aware* of the problems. The most *frequent* ones are presented in box 1.1, with suggestions how a famous native German speaker might terminate them. Perhaps these changes will one day become reality. Until then, spelling will remain an item to be considered carefully in

scientific manuscripts. One way of reducing the difficulties is to switch on a spellchecker and set it to correct when typing. Special words or abbreviations that are specific to a *particular* field can be constantly added to the main dictionary. In this way, the spellchecker can be trusted to correct spelling during typing. If it cannot correct a word, then that word will need attention. If you do not like your spellchecker to make decisions itself, turn off this option and manually check the words marked by the spellchecker. There is nothing wrong with this; you may even learn something. It is simply more time-consuming.

A spellchecker is, however, not perfect. At present, a spellchecker will fail to determine whether a word should be written in the singular or plural. Furthermore, it cannot deal with words that do exist in a language but that are used incorrectly. The twelve sentences in box 1.2 provide eleven such words. See if you can find them. Remember to keep an eye open for such errors when you read your work.

The grammar checker of Word 2007 is also a useful tool. It *detects* repeated words, sentences that do not start with a capital letter and unnecessary spaces. Its range also extends to more complex difficulties such as highlighting incomplete sentences, marking a lack of agreement between the subject and verb (e.g. "the majority of scientists is conservative", not "the majority of scientists are conservative") and highlighting *incorrect* tense constructions.

Like spellcheckers, grammar checkers are not foolproof and are to be used with care. Nevertheless, even if they are inaccurate, you still have to work out why the grammar checker has queried your writing. Anything that makes you think hard about what you have written and consider other possibilities will make a positive contribution to the quality of your text.

Box 1.1 Terminating difficulties in English spelling

This text lists most of the peculiarities of English spelling and offers some humorous suggestions to eliminate them. The text circulated by email at the time of Governor Schwarzenegger's inauguration and can still be found in many internet forums. I am grateful to the anonymous author. Read it out aloud to hear how it sounds!

A New Language For California

The new Californian Governor has just announced an agreement whereby English will be the official language of the state, rather than German, which was the other possibility. As part of the negotiations, the Terminator's Government conceded that English spelling had some room for improvement and has accepted a 5-year phase-in plan that would become known as "Austro-English" (or, perhaps even better, "Austrionics".). In the first year, "s" will replace the soft "c". Sertainly, this will make the sivil servants jump with joy. The hard "c" will be dropped in favour of the "k". This should klear up konfusion, and keyboards kan have one less letter. There will be growing publik enthusiasm in the sekond year when the troublesome "ph" will be replaced with the "f". This will make words like fotograf 20% shorter. In the 3rd year, publik akseptanse of the new spelling kan be expekted to reach the stage where more komplikated changes are possible. Governments will enkourage the removal of double letters which have always ben a deterent to akurate speling. Also, al wil agre that the horibl mes of the silent "e" in the languag is disgrasful and it should go away. By the 4th yer peopl wil be reseptiv to steps such as replasing "th" with "z" and "w" with "v". During ze fifz yer, ze unesesary "o" kan be dropd from vords kontaining "ou" and after ziz fifz yer, ve vil hav a reil sensibl riten styl. Zer vil be no mor trubl or difikultis and evrivun vil find it ezi tu understand ech oza. Ze drem of a united urop vil finali kum tru. If zis mad yu smil, pleas pas it on to oza pepl.

Box 1.2 Fooling a spellchecker

Word 2007's spellchecker considers the spelling of all the words below as being *correct*. Nevertheless, each sentence except one possesses a word that is spelled wrongly because it is used in an incorrect context. Find these eleven misspelled words and identify the one *correct* sentence without a spelling mistake. The solutions are given in section 1.6.1.

1. You must proof that two plus two equals four!
2. A prove that two plus two equals four is given on the first page.
3. Vaccines safe lives.
4. Spellcheckers chance the way we read our texts.
5. The theory of global warming remains to be proven.
6. Spellcheckers effect our ability to spell.
7. How do tortoises remain a life when hibernating?
8. Only a few scientists have received two Nobel Prices.
9. The affect of technology on the environment is substantial.
10. Tumour cells loose the normal controls of growth.
11. We judge how we live our lives form our own perspective.
12. The ability to write concisely and accurately is not heredity.

1.1.1 British or American?

Students have many questions at the beginning of a new course. The above question concerning the English to choose for their spellchecker is the most common. A *frequent* variant, often posed by post-graduate students and post-docs, is whether American English must be used to write a manuscript that will be submitted to an American journal. The answer to both questions is that it is not important which variant of English you choose. It is far more important that your English is clear, comprehensible and concise. An editor of a journal will not reject a manuscript because the spelling, vocabulary and punctuation are from an English-speaking person situated on another continent. Setting commas in the American way or writing "sulphate" instead of "sulfate" will not affect the fate of your manuscript. Once a journal accepts a scientific manuscript for publication, the production department will use its own spellchecker and software to put the manuscript into the style of the journal.

Variety is the spice of life.
ENGLISH SAYING

This chapter lists the words in this book that are printed in italics and the pages on which you can find them. Words from boxes 1.4 (linking words) and 1.7 (the basic scientific lexicon) appear in italics up to five times (section 7.1 and 7.2). Other useful words for scientific writing that are not contained in these boxes are printed once in italics (section 7.3). The lists, although extensive, cannot cover every word necessary for scientific writing. Expand the lists by adding words that you find useful when reading. Space is provided in section 7.4. When writing, try to use as many of the words from chapter 7 as you can. The more you *vary* your words, the livelier and more vivid your writing will be.

7.1 Linking words

accordingly 83, 90, 97, 105
additionally 56, 81
consequently 34, 51, 70, 113, 139
for example 23, 36, 69, 106, 152
for instance 33, 36, 40, 82, 92
furthermore 51, 84, 111, 134, 150
however 18, 35, 50, 55, 64
in addition 23, 24, 40, 85, 113
in contrast 34, 42, 50, 97, 106
in short 41
in summary 16, 98
indeed 33, 57, 62, 94, 102
instead 16, 22, 86
moreover 134, 156
nevertheless 12, 51, 60, 143, 164
occasionally 26, 73, 84, 92
of course 36, 48, 69, 95, 148
otherwise 35, 90, 131
subsequently 108
therefore 53, 59, 88, 98, 152
thus 59, 71, 98, 103, 143
to this end 102, 149, 164

Verbs

affect 55, 133, 144, 176
ask 88, 99, 128, 149, 163
attempt 79, 100, 127
cause 49, 88, 117, 133, 153
cite 84, 109, 110, 135
compare 119, 137, 141, 149, 164
conclude 62, 98, 141
confirm 47
confuse 90, 167
consider 36, 60, 156, 164, 173
correlate 45, 57, 135
decrease 48, 63, 64
demonstrate 45, 65, 116, 152, 170
describe 20, 65, 128, 129, 147
destroy 133, 138
detect 13, 40, 48, 108
disprove 69
document 137, 150
explain 68, 74, 88, 133, 175
find 40, 71, 112, 120, 176
follow 47, 108, 121, 150, 168
illustrate 50, 69, 105, 143, 165
increase 70, 80, 104, 134, 143
indicate 16, 95, 100, 121, 147
induce 150
interest 104, 105, 168, 169
invent 67
investigate 97, 123, 138, 145, 158
judge 39, 81, 101, 119
observe 31, 101, 116, 122, 152
propose 99, 101, 170
prove 69, 107, 174
quantify 84
quote 109
remain 44, 49, 113, 170, 173
repeat 107, 113, 132, 150
require 69, 108, 111, 136, 137
search 60, 127
shed light on 150, 158
show 102, 117, 132, 141, 147
solve 73, 172
strengthen 51, 96, 164
suggest 95, 147, 158, 163
support 80, 92, 109, 148, 157
survive 119
test 69, 95, 97, 172
treat 109, 120, 152
try 58, 73, 80, 131, 149
vary 61, 179
verify 108, 147, 160
work 71, 80, 85, 91, 119

Nouns

absence 16, 26
analysis 58, 64, 87, 155
answer 86, 92, 113, 147
appearance 24
application 21, 81, 112, 113
attempt 50, 105, 107
background 65, 69, 101, 109, 164
cause 53, 89, 120
chance 68, 79, 82, 112, 143
change 89, 112, 132, 137, 141
citation 109
condition 108, 138, 143, 150, 153
conflict 163
consequence 68, 101, 136, 137
constant 129, 132
control 30, 87, 121
data 59, 82, 87, 148, 158
decrease 63, 139, 143
difference 61, 75, 132, 147, 167
discovery 68, 73, 75, 149, 152
discrepancy 45
effect 44, 64, 89, 113, 141
enigma 174
equilibrium 68

event 11
evidence 69, 91, 99, 160, 164
experiment 95, 102, 118, 122, 150
figure 96, 108, 121, 124, 132
flaw 50
graph 90, 137
hint 27
hypothesis 45, 69, 95, 99, 148
idea 26, 60, 67, 127, 154
illustration 41, 127, 164, 175
image 91, 143, 144
inclusion 87
increase 132, 133, 136, 138, 143
incubation 95
ingredient 103, 128, 132
level 49, 57, 91, 136, 137
mechanism 175
model 91, 94, 136
observation 67, 69, 86, 96, 137
output 80
paradox 77, 158
parameter 44, 75, 131
participant 65, 155, 156
pathway 100
period 92, 98, 141, 142
possibility 92, 100, 163
presence 21, 65, 91
process 80, 96, 100, 127, 141
product 100, 136, 159
question 69, 86, 131, 145, 159
reason 50, 82, 156, 158, 163
relevance 60, 112
report 82, 137, 155, 167
research 71, 75, 137, 163, 177
result 23, 61, 77, 89, 132
role 71, 80, 153
situation 18, 36, 154
solution 48, 55, 88, 167, 173
specificity 31, 77
structure 35, 170
synthesis 129
table 85, 87, 92, 147, 148
theory 65, 75, 170
variable 45, 90
variation 24, 75, 91
variety 104, 137, 143
version 37, 47, 82, 111
volunteer 65
work 40, 59, 68, 73, 81

Adjectives and adverbs

able 12, 27, 36, 41, 47
active 38, 96, 100, 149, 170
actually 16, 59, 101, 108, 111
affected 63, 89, 172
aware 12, 35, 37, 48, 80
capable 100, 117
certain 16, 17, 33, 43, 48
closely 18, 36, 43, 69, 94
consistent 86, 112, 118
contradictory 22
correct 12, 15, 18, 51
dependent 90, 95, 97, 98
detrimental 150, 155
essential 12, 18, 21, 33
exactly 23, 47, 85, 112
exclusively 156
external 81
frequent 12, 15, 84
incorrect 13, 15, 148, 177
likely 38, 50, 68, 106
limited 11, 49, 50, 106, 141
necessary 36, 79, 87, 91, 137
noteworthy 63
particular 13, 65, 80, 99, 175
plausible 134
poorly 17, 34, 82, 112, 165
previous 22, 35, 107, 113, 152
prior 129
proportional 108
putative 63
relevant 33, 47, 81, 86, 94

resistant 104
robust 123
severe 48, 155, 156, 160
significant 35, 39, 40, 50, 145
similarly 17, 23, 45, 98
simultaneous 159
unable 35, 53

7.3 Words that extend the basic scientific lexicon

absolute 71
accelerate 141
accessible 97
achievement 112
adjust 115
alleviate 131
ameliorate 158
amount 63
analyse 163
anticipate 96
approach 113
assess 123
assimilate 12
assumption 72
augment 26
basis 145
circuit 42
clarify 79
comprehensible 124
concise 166
concomitant 143
controversial 159
convey 42
delve 109
develop 127
deviation 94
devise 84
diminish 143
effectively 96
eliminate 65
elucidate 177
endeavour 67
envisage 119
equal 143
estimate 26
evaluate 158
extensive 143
fate 134
findings 132
gain 74
genuine 99
gradually 55
growth 67
identical 143
imagination 67
imbalance 143
impact 19
inaccurate 81
incidence 57
inconsistency 40
inevitably 67
influence 152
initiative 41
insight 72
insufficient 92
intact 138
interpretation 164
lessen 160
modify 96
monitor 133
novel 117
omission 92
perspective 70
phenomenon 135
postulate 150
potential 123

precise 103
predict 147
preliminary 117
prepare 152
primarily 82
probability 61
promote 169
property 102
protocol 152
rate 61
recover 143
redundancy 112
refute 164
reliability 91
remarkable 171
resolve 103
responsible 104
salient 47
sensitive 144
source 48
speculate 74
stipulate 111
succinct 105
superfluous 39
survey 131
system 91
technique 38
underestimate 57
vague 176
value 124
various 149
virtually 145
vital 106
worsen 58

7.4 Words that you wish to add

Use the space on the subsequent pages to collect further useful words and phrases.