Building Skills

Writing a Scientific Paper for Publication

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Scientific research is a virtually worthless pursuit unless it is described in writing. Scientific research is not complete until results have been published.

This module will help in all aspects of writing up papers and reports. The language now most commonly used is English. Sorry about this but it is the current way to do things.

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1. Why write?

1. Why?

Writing helps us formulate ideas and provides a permanent record.

You can learn the skill by following advice of experienced scientists.

You can learn by reading widely and thinking critically about the quality of what you are reading.

You need constant practice to develop the clarity of style that is essential to good scientific writing.

THERE ARE THREE fundamental aspects to good science writing

1. Planning structure.
2. Your reader.
3. Choosing your words.

1. Why the 'Write up'

A few facts first:

a. Scientific research is not complete until results have been published.

b. Scientific research is a virtually worthless pursuit unless it is described in writing.

c. New discoveries and processes must be conveyed to other interested parties in a manner that differs from most other writing forms.

d. The purpose of science writing is to inform, BUT it should allow the reader to repeat an experiment and verify published results and/or use published results as a guide to related research.

e. Papers are a permanent record of work and historical documents.

f. Papers help avoid repetition of work by others.

g. Papers value add to knowledge base.

h. Papers invite critical analysis.

i. Papers can attract funding.

j. Papers give great personal satisfaction.

2. Science writing is highly formalised

a. The writer must be clear and concise.

b. To some degree elements of style can be sacrificed toward these goals.

3. The vision in planning research should enable seeing a paper's structure and even conclusions

determined by the actual results obtained and their analysis.

Essentially a paper should be almost written at the planning stage since here we lay out the key components involving:

Hypothesis.

Methods.

Possible results (data analysis).

Decision points.

Possible conclusions dependent on results.

Figure 1 shows a rather simple example to show that most of the planning covers a paper. The main problem is gathering and analysing data. So we already have a major template form the paper though the experimental design.

f the planning is poor then of course the paper is not written. Poor planning and changing plans in the middle of experiments leads to confusion. Decision points dependant on data have to be foreseen.

Here a bag containing 100 balls is given. The balls are either black or white, they may be all black or all white or a combination. A hypothesis (trivial) is made that they are all white.

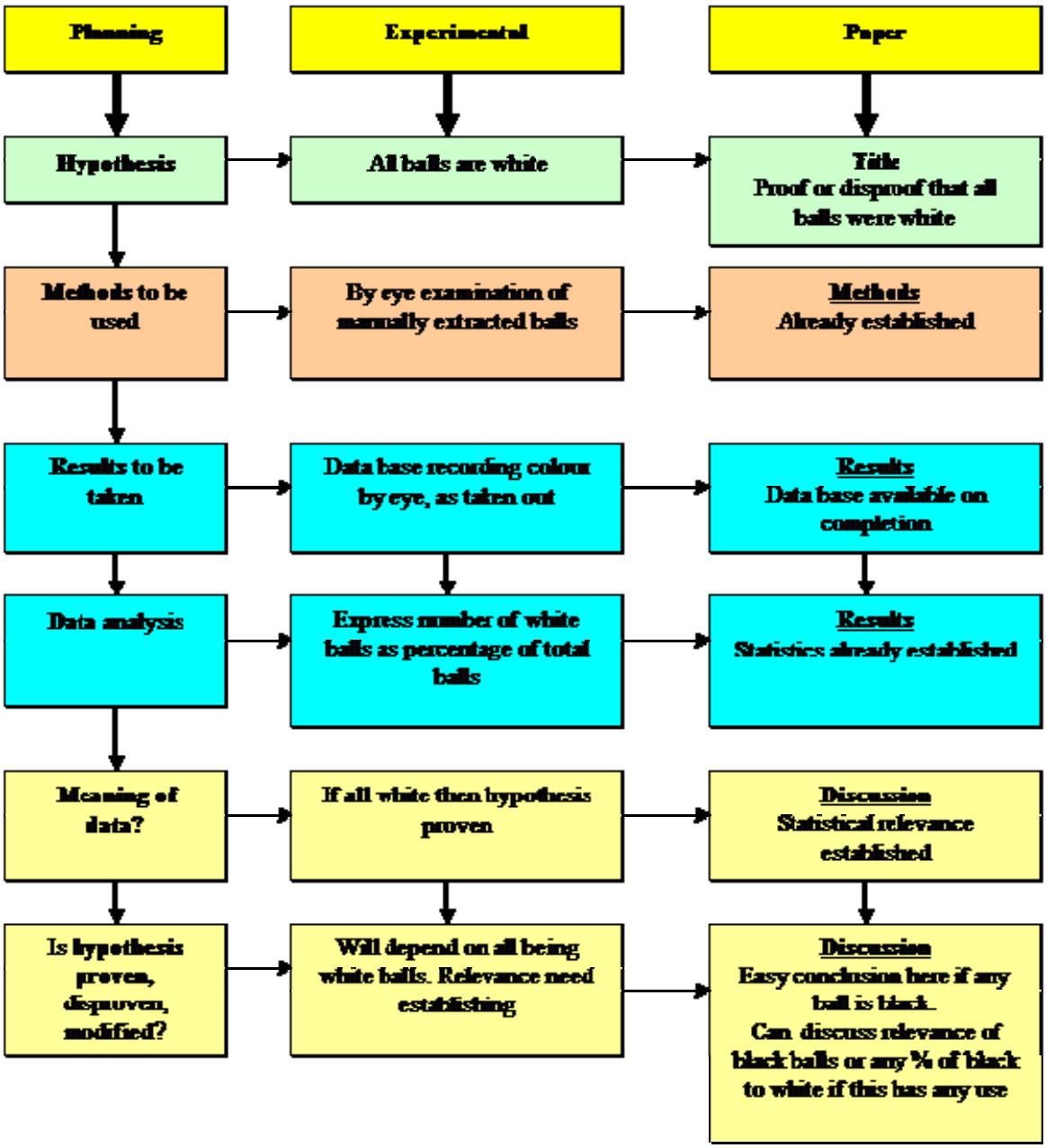


Figure 1. Planning the experiment should outline the plan for the paper

2	Structure of scientific journal papers

Structure of papers

The scientific paper is highly structured and has fixed headings:

1. Title
2. Abstract (also called summary)
3. Introduction
4. Materials and Methods
5. Experimental Results (Results)
6. Discussion, (Discussion and Conclusions)
7. Literature Cited 8. Acknowledgments

Figure 1 shows the mess we can get into where methods, results and discussion are mixed.

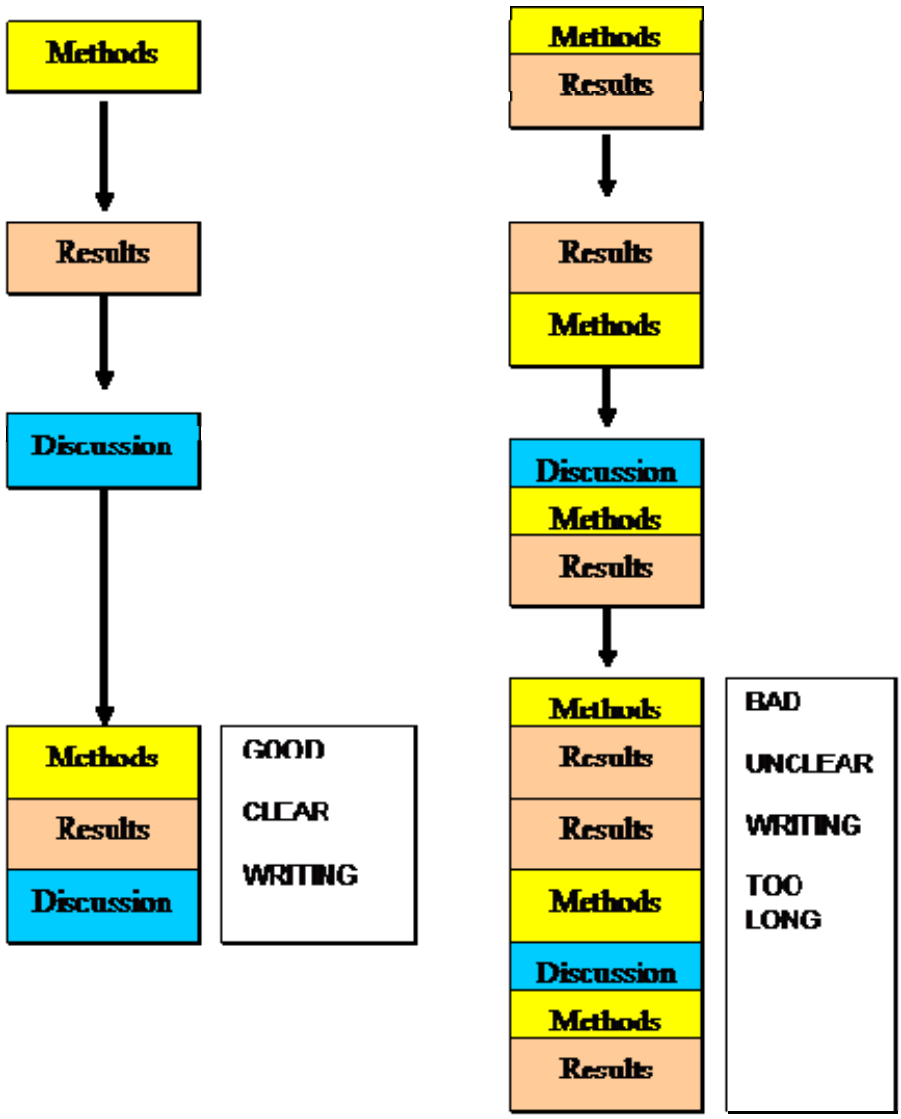


Figure 1. The good paper on left, has clear divisions for methods, results and discussion. The bad paper on right, mixes a these at all levels and is usually too long, confusing and therefore unsuitable for publication.

This type of mixing is most common in scientists when they begin to write up material.

So the use of formal devices like subheadings, tables, figures and diagrams is nearly always appropriate.

Sensible use of subheadings helps define the structure of your work, and makes it easier to avoid linking sentences.

Tables, figures and diagrams, collectively referred to here as illustrations, should always be used where they will save words or make your argument clearer. However, you must make sure that your reader does not need to refer to them in order to follow the general flow of your arguments.

1. Title

1. Title is important.

Make the title as short as possible including main points.

2. Do not put a question in title.

3. Avoid phrases such as:

'Studies on'

'Characterisation of'

'Observations on'

'Investigations into'

Never use 'novel'

4. Avoid jargon.

5. Avoid abbreviations in title.

6. Look at syntax carefully.

2. Abstract

1. The Abstract is a summary of the paper.

2. The Abstract is the first part of the paper to be read BUT should be is the last part to be produced.

3. The Abstract assists others to decide whether to consult the full text of the paper.

4. A bad abstract might indicate to others that this is a basd paper.

5. The Abstract must be brief and yet it should describe the scope of the paper, summarize its results and state its conclusions.

6. Use a single paragraph with a maximum of 250 words

7. Past tense

8. No references.

9. No abbreviations (maybe DNA).

If there is a massive need for a reference then it must be FULL.

10. State principle objectives.

11. Summarise methods (brief).

12. Summarise main results.

13. Summarise main conclusions.

3. Introduction

1. The Introduction should include a general statement of the scope of the problem

2. A brief summary of background information.

3. State method of investigation. Main results. Main conclusions

3. Use present tense for already published work

4. The opening sentence should be a specific statement.

5. Include only information that directly relates to your topic.

6. Be sure to give credit to all sources from which you have taken ideas

7. Supply information to provide context without referring to previous publications

8. Do not embellish the Introduction

4. Materials and methods

This section should answer the question, "How?"

1. Use the past tense.

2. Give enough detail to allow experiments to be REPEATED.

Experimental design should be described in detail, including equipment and methods. Details of concentrations and chemicals used are obviously important. It is not necessary, however, to give a recipe.

3. Describe general method used.

Step-by-step procedures are generally not needed unless they are original

4. New Methods require full detials.

5. List methods in same order as in results section.

Minor variations should be described in figure legends or text

6. Care with syntax

After standing in boiling water for 10 min, I loaded a sample on gel

7. Consistency in text (10000 x g for 30 , min at 40oC).

8. Compounds detailed if needed at certain purity, commercial products with advantage.

9. Nomenclature correct.

Compound names etc.

10. Biological materials need defining.

Source, how made, genotype, phenotype? Use table where large number

11. SI units but look at the Journal rules.

12. No results in methods section.

5. Results

1. Use the PAST tense.

2. Be selective (not all results from work have to be there).

3. Place in a LOGICAL ORDER (this need not be the order you did experiments).

4. Put discussion ONLY in Discussion section.

5. Results should be included ONCE only.

6. Figures and Tables.

a. Each should save words or make a point clearer.

b. Each needs a number and an informative title.

c. Each must be intelligible to the reader without reference to the text (if necessary give it a legend as well as a title).

d. Each must be referred to, in the text, by its number and in the order they appear in text.

e. The sense of the text must be intelligible without reference to the illustrations.

f. Acknowledge sources of material adapted or copied from elsewhere.

g. All tables and figure should have a title and legend.

Legends

1. A short sentence indicating what it is about.

2. Says what figure shows.

3. Enough information to avoid having to go to main text.

4. Information as to conditions.

5. Consistent, sensible symbols.

7. Quantitative results may be listed numerically in tables or shown in graphs.

If the data shows a numerical trend, use a graph.

8. Statisitics must be MEANINGFUL.

Thirty-three percent of the mice used in the experiment were cured by the test drug; 33% of the test population were unaffected...and the third mouse got away.

All experimentally measured quantities should be quoted with errors and with the correct number of significant figures. Always use the standard deviation as the standard, statistical, measurement error.

6. Discussion

1. The purpose of the Discussion is to show the relationships indicated by your results.

2. Discuss, do not repeat the results.

Point out exceptions and unsettled points in your data.

3. Indicate how your results agree or contrast with previously published or accepted data.

4. State your conclusions as clearly as possible and summarize evidence for each conclusion.

5. Keep in mind that the very nature of scientific research will limit the number of conclusions that you should expect from any experimental process.

6. Mixed tense since past and present work discussed.

7. Do not repeat results at any length (reminders allowed).

8. Crisp focus-avoid speculation.

9. Contribution to knowledge field?

10. End with a high note.

e.g., Pose new question

Say how work will continue

Restate main findings and implications

7. Literature Cited

The bibliography is placed at the end of the paper.

8. Acknowledgements

Using English in writing up science papers

 Some simple rules
 English style in scientific writing
 Some common errors in writing English

Some simple rules

1. Keep writing simple

2. Make simple sentences

3. Use simple words

4. Avoid split infinitives

5. Look for and avoid ambiguity

6. Avoidance words and phrases list

Quite	AVOID
It has been shown that	AVOID
Only	Care
While	Do not use this for whereas
Prior to	Use- before
In the event that	Jargon AVOID
At this point in time	Jargon AVOID
Experiment was ‘carried	AVOID

In the event that	AVOID

7. Never start any sentence with 'it' in fact avoid 'it' anywhere in text

8. Avoid general descriptions such as 'substantially', ff you have any statistical measure then you have defined the degree and can state this.

9. Use 'which' and 'that' carefully

'Which' is non restrictive

'That' is restrictive

10. Active voice is best (shorter). Always review for this!

e.g. S. aureus produced lactate (ACTIVE 3 words)

Lactate was produced by S. aureus (PASSIVE 5 words)

11. Numbers

Never start a sentence with a numeral

You can have a number but as a word

One digit numbers are spelled out

Two or more digits are numerals e.g. three experiments and 12 experiments

In a series of numbers in a sentence where one is greater than one digit then use all as numerals e.g. I gave A to 3 rats, B to 6 rats and C to 9 rats

12. Punctuation

BE VERY CAREFUL, they alter meanings of sentences

13. Jargon

Avoid all jargon

Identify this and take it out

14. Avoid cliches

15. Avoid all pointless expressions

16. Avoid euphemisms

Be concise

Clear thinking and careful planning lead to economy of expression and avoidance of repetition and padding.

Use simple words

Good style does not require you to be pompous or flamboyant; 'purple passages' rarely enhance your arguments.

Write short sentences

Some experienced writers can write comprehensible long sentences; most cannot. If you find yourself writing a sentence of more than about 40 words, consider ways in which you could divide it.

Take care with your grammar

Incorrect or slipshod grammar often obscures your meaning and can irritate your reader even when the sense is clear. Here is what

Beware of fashion

Words and phrases can become fashionable and over-used, and their meaning often becomes uncertain.

Use your own words

Copying other people's words (or original ideas) without acknowledgement is plagiarism. This is always dishonest and wrong, and in the university context it can lead to severe penalties. Sometimes it may be useful to quote passages from someone else's work, but in most of your work it is unlikely to be either necessary or desirable. If you really believe that someone else has said exactly what you want to say then do not make minimum alterations and pretend you are using your own words; quote verbatim using quotation marks and acknowledging your source.

Use words correctly

Always write with a good dictionary at hand and check whether a word means exactly what you think it means. If you have a word whose meaning is not quite right you might find it useful to use a thesaurus. Avoid using inverted commas when you want to indicate to your reader that you have used an inappropriate word which needs translating.

Use words that your reader will understand

Remember that knowledge of technical expressions (jargon) is often limited to a comparatively small group of experts. You should avoid using such expressions unless they provide the only sensible means of saying what you want to say. If you do use them, explain their meaning if there is a risk that your reader will not understand them. Avoid trying to impress by using grandiose words that your reader (and even you yourself) may not fully understand.

Spell correctly

Bad spelling may distract and irritate your reader. Use your dictionary.

Take care with the use of 'I'

It is a difficult pronoun for most inexperienced writers of science to use confidently and without causing annoyance (particularly to members of an older generation who were brought up with the mistaken belief that impersonality confers impartiality). However, never go to such lengths to avoid 'I' that your prose becomes ugly and clumsy. Try, for example, ways of eliminating the 'I' from this memorable sentence:

Data, media, strata, criteria, bacteria and phenomena

Data, media, strata, criteria, bacteria and **phenomena** are plurals of **datum, medium, stratum, criterion, bacterium**, and **phenomenon**, respectively.

Data, media, strata, criteria, bacteria and phenomena should be used with plural verbs.

Wrong: The **data** Tom showed was convincing.

Right: The **data** Tom showed were convincing.

Wrong: **Bacteria** is growing well at room temperature.

Right: **Bacteria** are growing well at room temperature.

Farther/further

When physical distance is to be referred, always use **farther**– the word that has **far** in it.

Wrong: Salzburg is **further** north than Vienna.

Right: Salzburg is **farther** north than Vienna.

Use **further** to refer to additional time or amount.

Wrong: This requires **farther** study.

Right: This requires **further** study.

Wrong: Schedule the meeting **farther** in the future.

Right: Schedule the meeting **further** in the future.

Right: The **father** you travel on your holidays, the **further** your bank account will drop.

Fewer/less

Fewer refers to things that can be counted.

Less is used for things that cannot be counted.

Wrong: **Less** people attended the conference this year.

Right: **Fewer** people attended the conference this year.

Note: In some cases, when referring to time or money, **less** is correct.

Right: It took Harinder **less** than five minutes to spend a little **less** than one hundred euros.

Imply/infer

Imply means to state indirectly. **Infer** means to draw a conclusion.

Wrong: Tom meant to **infer** that George was misinformed, not lying.

Right: Tom meant to **imply** that George was misinformed, not lying.

Wrong: From the size of his house, she **implied** that he was rich.

Right: From the size of his house, she **inferred** that he was rich.

That / which

That is properly used to introduce a restrictive, or defining, clause (which identifies what is being talked about) and is not preceded by a comma.

Wrong: Tom liked the pen **which** I gave him.

Right: Tom liked the pen **that** I gave him.

Which is used to introduce a nonrestrictive or non defining, clause (which gives additional information about the subject that has already been identified) and is always preceded by a comma.

Wrong: The pen I gave Tom, **that** he liked, was made in India.

Right: The pen I gave Tom, **which** he liked, was made in India.

In some cases it is allowed to use **which** to introduce a restrictive clause to avoid repetition of the word **that**:

Right: I gave Tom **that** pen **which** I bought from India. (note: no comma before which)

Affect/effect

Affect means to have an influence on or cause a change in. **Effect** means to produce a result or bring about.

Wrong: Excessive drinking can adversely **effect** health.

Right: Excessive drinking can adversely **affect** health.

Wrong: Quitting may **affect** an improvement.

Right: Quitting may **effect** an improvement.

(**Effect** is also used as a noun. Excessive drinking can have an adverse **effect** on health)

A/an

Use **a** before words beginning with a consonant or consonant sound, and use **an**before words beginning with a vowel or vowel sound (the vowel **u** often has a consonant sound at the beginning of words such as **university** and **union**, and therefore must be preceded by a even thought they start with a vowel).

Wrong: Roth is **an** skilled technician.

Right: Roth is **a** skilled technician.

Wrong: He took **a** apple, cut it into pieces and then homogenized.

Right: He took **an** apple, cut it into pieces and then homogenized.

Some words starting with **h**, have **h** silent, as in *hour*. Use **an**.

For words such as *hotel* and *historical*, use **a**.

Comprise/compose

The whole **comprises** the parts, and the parts **compose** the whole.

Wrong: The team **composes** three scientists.

Right: The team **comprises** three scientists.

Wrong: Three scientists **comprise** the team.

Right: Three scientists **compose** the team.

Wrong: The team is **comprised** of three scientists.

Right: The team is **composed** of three scientists.

If you find this confusing, use **makeup**.

The team is **made up** of three scientists.

Or

Three scientists **make up** the team.

Comma

Effective use of the **comma** is determined as much as by commonsense and by good taste as by grammatical regulations. It serves several purposes: to separate, to introduce, to enclose.

Right: Since arriving at Sheffield Park, the engine, preserved in Southern Railway olive green livery, has been a stalwart on the line, giving many miles.

'Try not to scratch and see your doctor if any reactions persist' should be 'Try not to scratch, and see your doctor if any reactions persist' (see your doctor should be closely related to what follows it, not to what precedes it).

Commas are needed to separate phrases from their context.

'We stood by a wall sipping coffee provided by the host' should be 'We stood by a wall, sipping coffee provided bythe host'.

Use a comma to separate a series of words or group of words. Place a comma before the *and* preceding the last item.

Right: We arrived at the airport, waited in line, checked our baggage, and walked down the concourse to our plan.

Right: I placed the order for magazines, newspapers, journals, and newsletters.

Use a comma after an introductory word, phrase, or clause.

Right: She needed only one thing, money.

Right: Yes, the Research Evaluation Department will attend the meeting.

Use a comma to separate two or more adjectives that describe a noun (note: the comma is taking the place of the word *and*)

Right: Arizona is a hot, dry state.

Right: The applicant was professional, knowledgeable, and experienced in the area of accounting.

Use commas to enclose the name of anyone you are writing directly to when the name is used in the body of your document.

Right: Thank you, Smith, for responding so quickly to my request.

Right: I am counting on you to get the order processed this week, Ms. Schellander.

Use commas to enclose parenthetical words, phrases, or clauses.

Right: The additional supply order, however, will not be processed until early tomorrow.

Right: Mr. Timothy Smith, our new manager, will be introduced at our next meeting.

Use a comma to separate two independent clauses joined by a conjunction. Remember: BOYS FAN (but, or, yet,so, for, and, nor)

Right: There are two job openings for a person with molecular biology experience, and I know you will get one.

Right: We would like to have our Staff Council members to attend the conference, but we cannot afford the high cost.

Semicolon

It functions as a stronger breakthan a comma.

Use a semicolon to separate two or more independent clauses related in meaning and not joined with a conjunction.

Right: Operations tripled productivity in the first six months; finance doubled productivity.

Right: The new employee was perfectly suited for his new job in the research department; he learned the procedures and systems in less than a month.

Use a semicolon to separate equal parts of a sentence when commas would be confusing.

Right: The officers of the Staff Council are John Romero, President; Susan Greenberg, Vice-President; Timothy Smith, Treasurer; and James Jackson, Secretary.

Use a semicolon to separate two independent clauses joined by a transitional expression (consequently, nevertheless, however, therefore, in fact)

Independent clause–semicolon–transitional expression–comma–independent clause.

Right: He worked overtime to solve the computer difficulties; in fact, he rarely got home before 10 p.m. each night.

Right: Tom was terrific in dealing with difficult customers by phone; consequently, we forwarded all the tough calls to him.

Colon

The **colon** marks a slightly stronger break than does the semicolon and a slightly weaker breakthan does the full stop. The most common use of the **colon** is for connecting general statements with specific instances. It signals to the reader that there is more to come.

Use a colon to separate a title from a subtitle in a book.

Quantification of tannins: A laboratory manual.

Use a colon to introduce lists.

The committee consisted of twelve members: a chairman, a vice-chairman, asecretary and nine other elected members.

Dash

It is an emphatic mark. It indicates a sudden interruption in thought. There are no spaces on either side of the dash. Be careful not to overuse it.
Right: Power, fame, and money–these were his aspirations in life.

Parentheses (singular: parenthesis)

They are used to enclose nonessential material. They signal ‘by the way’ to the reader. Do not over use them.

Use parentheses to enclose material connected with its surrounding text.

Right: The illustration (see page25) is very important.

If the material enclosed falls at the end of a sentence, the end mark is placed outside the closing parenthesis.

Right: We provide a complete list of stores (in the appendix).

If the material is a complete sentence within itself, the end mark is placed inside the closing parenthesis.

We provide a complete list of stores. (see the appendix.)

Quotation marks

They are marks of enclosure for words, phrases, clauses, sentences, or paragraphs.

Quotation means repeating or copying what someone has said or written.

Periods and commas go inside the closing quotation mark.

“I wanted,” he said “to go home.”

Colons and semicolons go outside the closing quotation mark.

The following animals are considered ‘marsupials’: kangaroo and koala.

Question marks and exclamation points go inside the closing quotations mark when they are part of what is being quoted.

“How is your pain?” I asked.

Compare to/with

When this expression is used, care must be taken to preserve exact parallelism between the items compared.

Wrong: **Compared with** old technology, the great advantage of a Musto is the way it copes with changing conditions (this sentence compares the advantage of a Musto with old technology)

Right: **Compared with** the jackets made by the old technology, a Musto has the great advantage that it can cope with changing conditions.

Wrong: **Compared to** the Eighties, more of us visit the dentist at least once a year (it is incorrect to compare the Eighties with ‘more of us’. It is correct to say ‘**Compared to** Eighties, Nineties are…..’

Each

It is a singular pronoun and must be followed by a singular verb.

Right: Although each of the scenes is relatively short, they move smoothly from one tothe next.

Similarly use a singular verb after: each one, every, everyone, everybody, either, neither, nobody, no one, anyone, anybody, another, one, somebody, someone, and much.

And

A compound subject (more than one subject) joined by **and** requires a plural verb.

Wrong: Completing the form **and** mailing it promptly *is* important.

Right: Completing the form **and** mailing it promptly *are* important.

Wrong: Smith **and** Roth has resigned over this matter.

Right: Smith **and** Roth *have* resigned over this matter.

Right: Tom **and** Harinder *have* submitted *their* proposals.

Or/nor

A compound subject joined by **or** or **nor** takes a singular verb.

Right: The chairman or the president is willing to discuss the financial goals for the year.

Right: Either Bill **or** Smith will have to give up *his* office.

Either/or and neither/nor

In **either / or** and **neither / nor** constructions, the verb agrees with the nearest subject.

Right: **Either** the employer **or** the *employees are* going to pay the tax.

Right: **Neither** the buyers **nor** the sales *manager is* in favour of the system.

Right: Neither Mr. Pintoo **nor** *his employees have* reached *their* goal.

Both, few, many, others, several

Use a plural verb after these words.

Right: **Both** maps *are* out of print.

Right: **Many** *were* invited, but **few** *were* able to participate.

Collecting nouns

If the group is acting as a unit, use a singular verb.
The **staff** *supports* the move.

The **Board of Directors** *meets* on Wednesday.

Apart from

These words isolate an item as exceptional in relation to a statement.

Right: **Apart from** a few sweets, I did not buy anything.

Apostrophe

Where a plural noun ends in **s**, as most of them do, it is proper to add the apostrophe without a further **s**.

Right: Specializing in ladies' leisure footwear.

Ages and decades in figures should not have apostrophe.

Wrong: Tom seemed to be in his **30's**.

Right: Tom seemed to be in his **30s**.

Wrong: A farm dating from the **1960's**.

Right: A farm dating from the **1960s**.

Array

Array is a singular noun.
Right: His **array** of questions was not clear.

As

Where **as** is used to introduce appositional phrases the connection between the phrase and the subject it amplifies must be preserved.

Right: **As** a businessman he was a failure.

Wrong: **As** a self-employed businessman, Tom's car is his second home (The car must not be said to be a businessman)

Right: **As** a self-employed businessman, Tom finds his car is his second home.

Like

Never use **like** before phrases and clauses, where **as, as though, as if** or **that**is proper.

Wrong: **Like** I said before, it is true.

Right: As I said before, it is true.

Wrong: I feel **like** I should go.

Right: I feel **that** I should go.

Wrong: He looks **like** he is happy.

Right: He looks **as if** (**as though**) he is happy.

Right: He looks **like** his brother and walks like him.

Right: He does not feel **like** eating or drinking.

Its

Its is a possessive pronoun and does not need an apostrophe to make it indicate possession.

Wrong: The cow wagged **it's** tail.

Right: The cow wagged **its** tail.

Wrong: **It's** a very bushy plant.

Right: **It's** (It is) a very bushy plant.

Most/more

Never use **most** or **more** when –est or –er is added to a modifier.

Wrong: That is the **most stupidest** thing I have heard.

Right: That is the **stupidest** (or **most stupid**) thing I have heard.

Wrong: Your laboratory is **more roomier** than mine.

Right: Your laboratory is **roomier** (or **more roomy**) than mine.

None/nobody/none

Two negatives (such as nobody, no, none, not, cannot, could not, would not, should not, never, nothing, hardly)should never be used in the same statement.

Wrong: I told him he could not have **one**.

Right: I told him he could not have **any**.

Wrong: The plays he called **hardly never** seemed to work.

Right: The plays he called **hardly ever** (or **never**) seemed to work.

These/those

Pronouns must agree in number with the words to which they refer. These and those are plural of this and that.

Wrong: **Those** (**these**) kind of feed is toxic.

Right: **Those** (these) **kinds** of feed are toxic.

Can/may

Can denotes the ability to do something.

May denotes permission top do something.

Wrong: **Can** I read your paper?

Right: **May** I read your paper?

Good/well

Good should be used with descriptive verbs such as look, feel, sound, and taste.

Wrong: This cake tastes **well**.

Right: This cake tastes **good**.

Use **well** with all other verbs.

Wrong: The team played **good** yesterday.

Right: The team played **well** yesterday.

Note: Use **well** to refer to one's state of health, and use **good** to refer to one's appearance.

Advice/advise

Advice: *noun;* recommendation, opinion.

Advise: *verb*; to counsel.

Among/between

Among: *preposition*; used for more than two

Between: *preposition*; used with two persons/things.

Principal/principle

Principal: *noun*; main, chief

Principle: *noun*; rule standard, general truth

North/south/east/west, and their derivatives

Capitalize them, as

in the North

back East

the West Coast

Do not capitalize these words when they merely indicate directions or general location.

Drive north on n-70 and then west on Highway 10.

Seasons

Do not capitalize the seasons of the year

fall meeting

spring conference

Titles of headings

Capitalize all words with four or more letters. Also capitalize words with fewer than four letters except:

Articles: the, a, an

Short conjunctions: and, as, but, if, or, nor

Short prepositions: at, by, for, in, of, off, on, out, to, up.

Note: Even the articles, short conjunctions, and short prepositions should be capitalized when they are the first and last words of a title.

Right: ‘How to Deal With Difficult Groups’

Numbers

Expressed in words:

Numbers from one to ten: five, seven, ten (exception: a series of numbers, any of which is over ten. An example: We need to purchase 5 rolls of tape, 8 pencil, 12 file covers, and 5pen.)

Numbers beginning a sentence: Five hundred researchers attended the conference.

Ordinal numbers expressed in one or two words: in the twenty-first century, the division’s fortieth anniversary.

Exact or approximate numbers that can be expressed in one or two words: twenty-five visits, more than two million dollars.

Smaller of two numbers when used together and one is part of a compound modifier: Three 30-pound cartons, 20 four-cent stamps.

Who/that

Always use **who** to refer to persons, and use **that** to refer to animals and things.

Wrong: The man **that** lost was very unhappy.

Right: The man **who** lost was very unhappy.

Wrong: This is the cow **who** gives 40 litres milk per day.

Right: This is the cow **that** gives 40 litres milk per day.

Wrong: Tom cut the tree **who** died.

Right: Tom cut the tree **that** died.

All right/alright

All right is the only accepted form.

Along with

Care must be taken with the verb after **along with**. Use singular form of the verb.

Along with does not work like **and**. Tom and Harinder were present at the meeting, but Tom, **along with** Harinder, **was** present at the meeting.

Although

Although should be used to introduce a genuine contrast.

Right: **Although** it was raining heavily, we continued to play.

Wrong: **Although** it was sunny, we continued to play.

When **although** introduces a descriptive phrase, care must be taken to preserve accuracy in matching.

Right: **Although** a very young man, he had bad health.

Wrong: **Although** a very young man, his health was bad (his health was not a young man).

Anyone

It is not permissible to follow **anyone** with a negative verb.
Wrong: **Anyone** who hands in a gun will not be prosecuted.

Right: **No one** who hands in a gun will be prosecuted.

Writing up in the context of how your planned research is progressing

1. Experimental progress

The following figures illustrate some features of research which can be split up into experiments or investigations.

Usually there is a continuity planned where one experiment leads to another.

There may be a good deal of dependency on results or developments in one experiment by the next.

Sometimes a careful reassessment of progress can lead to a change in perspective with reference to writing up.

2. Idealised progress fitting plans

Figure 1 shows an idealised set of experiments planned and made allowing a paper to be written up.

Experiment 1 yields data to allow Experiment 2, etc., to a final Experiment 4 which gives data to allow some hypothesis to be

proven.

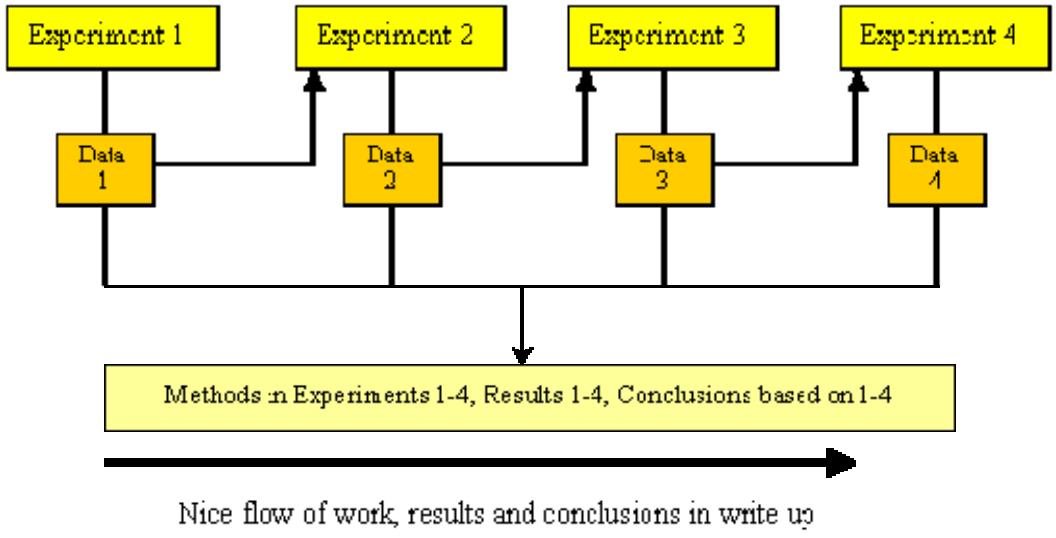


Figure 1. Perfect scenario for planning, data and experiments leading to writing a paper

3. Not so ideal progress

Figure 2 shows a much more common situation where problems are seen in either obtaining data or in fact where data indicated a change in plan.

Here, Experiment 2 cannot be done without development of other methods. This takes time and is not necessarily successful.

A change in direction may be needed where developments do not work.

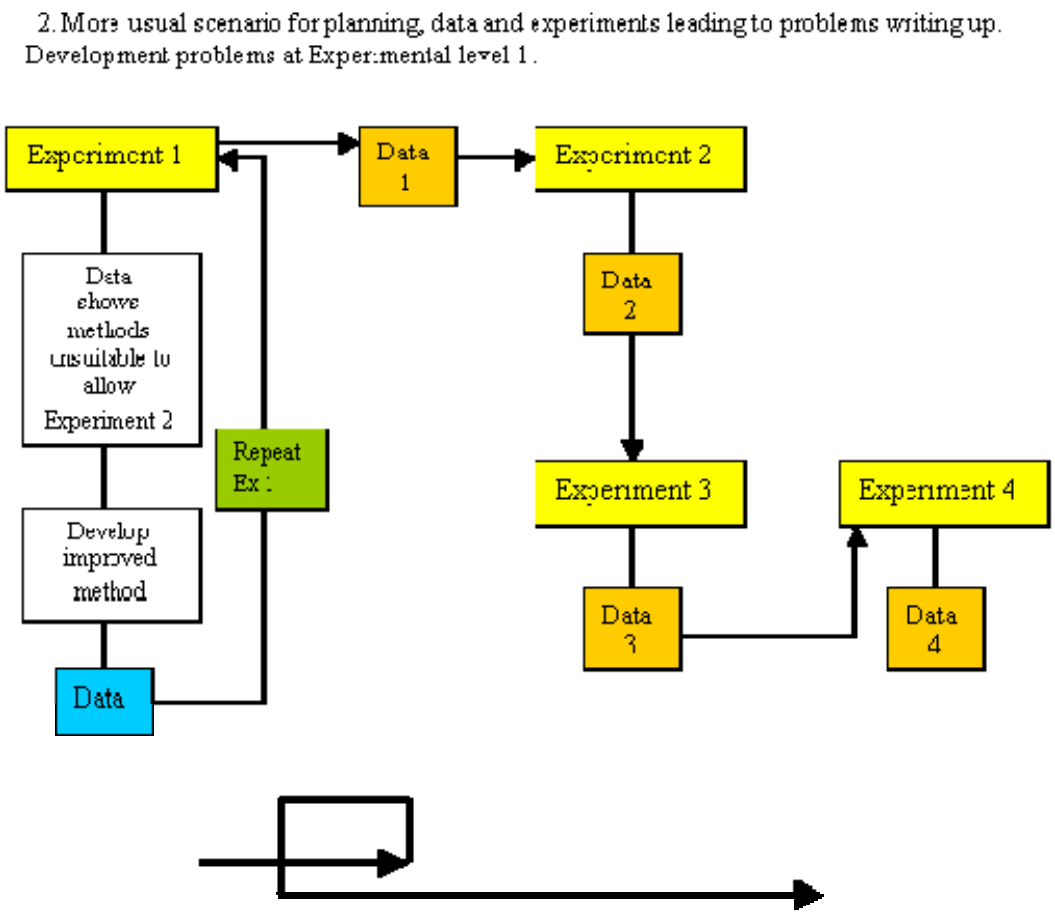
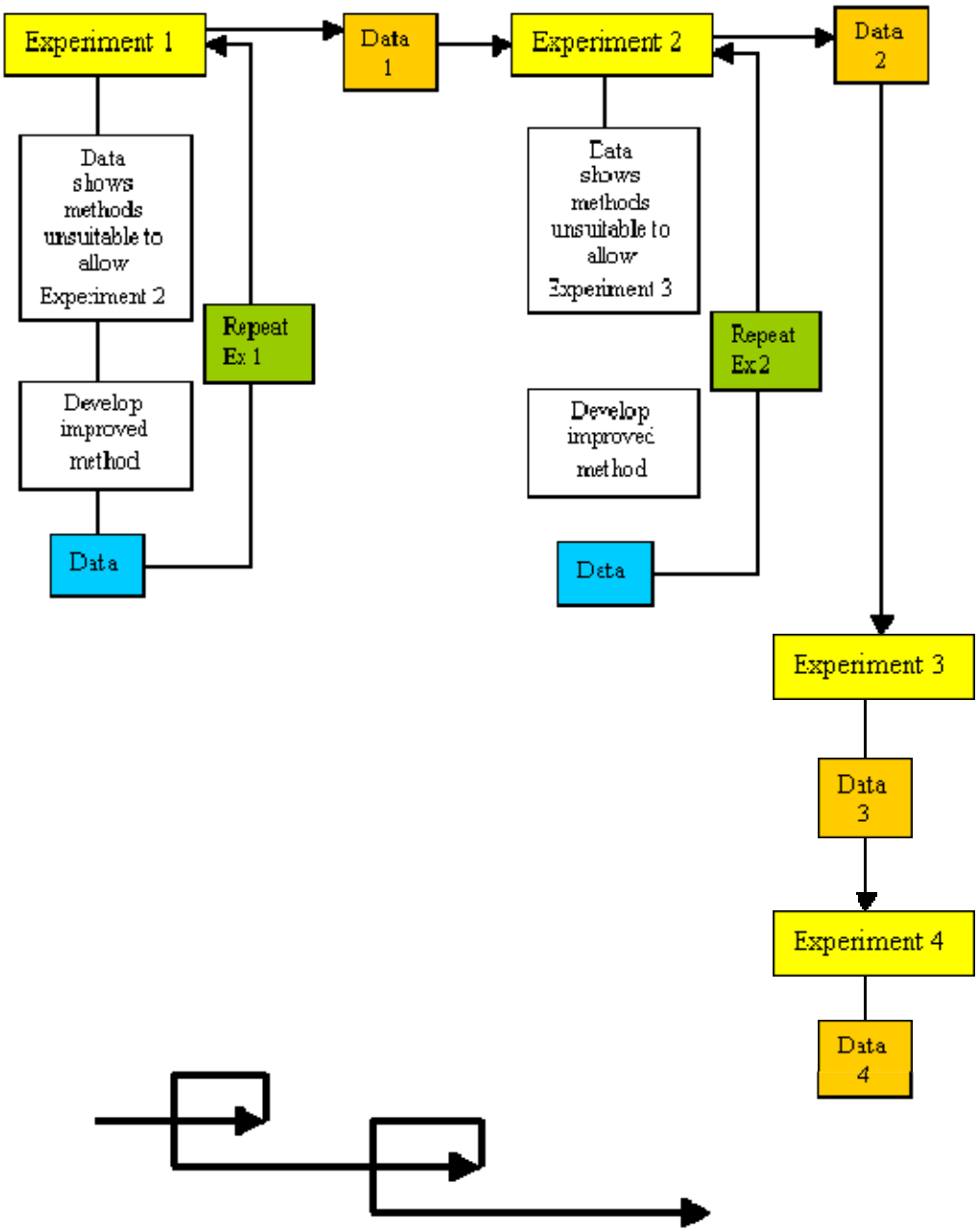


Figure 2. Complications of needing to develop tests to progress

4. Even less progress and some doubts creep in

Figure 3 shows a more complicated situation where developments are needed before experiments 2 and 3.

One might start doubting the original plan at this stage where such needs were not envisaged.



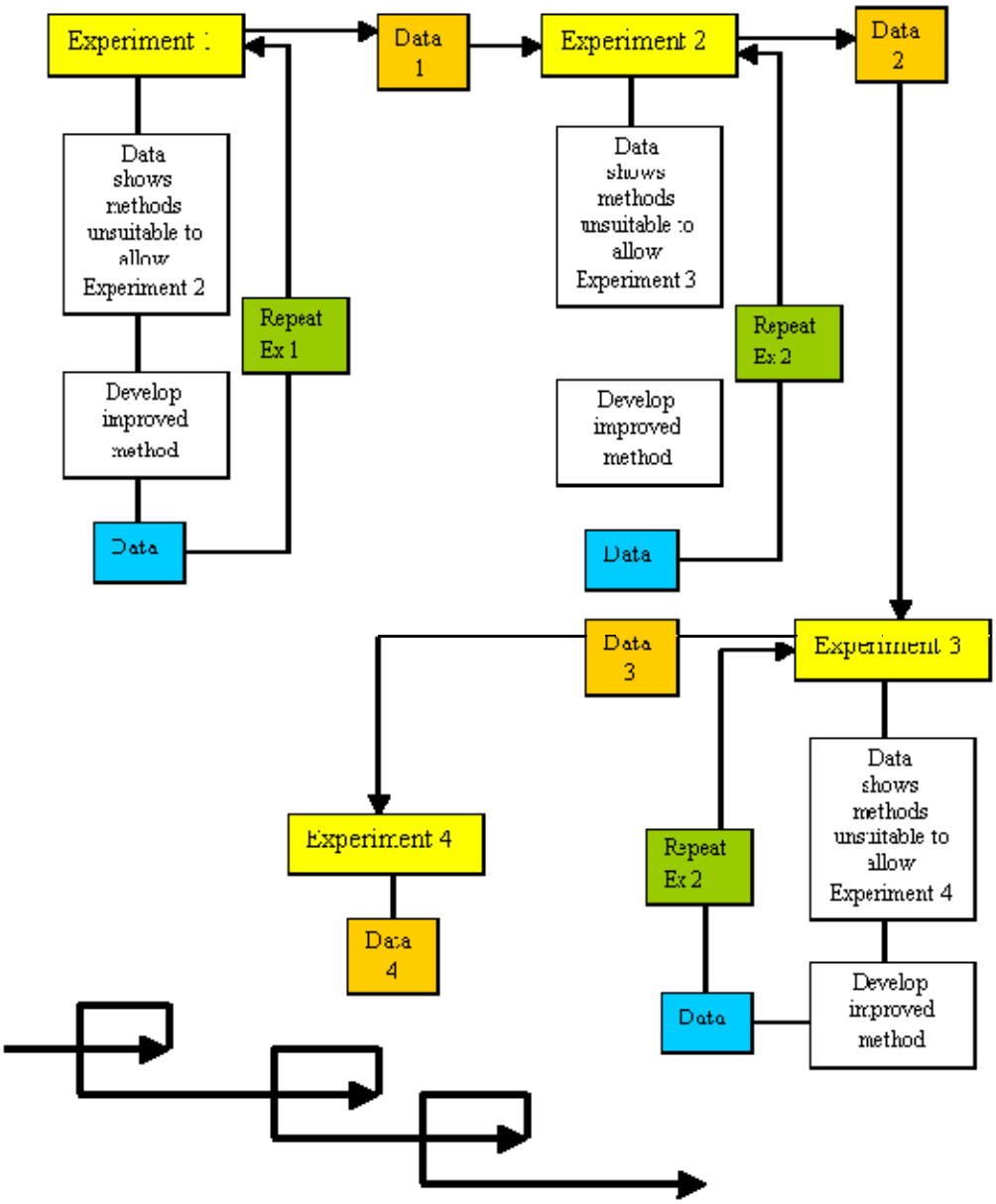
3. Some development has to be made in Experiment 2 as was needed in Experiment 1. So we have 2 problem areas to deal with when writing up. Again we could ignore the 'preliminary' experiments ensuring success for 1 and 2, and write up as though the flow (given the revised methods) was from 1 to 4 without seeming interruption. The extent of assessing experiments as preliminary and not referring to them in time otr text, depends on their relative importance to the overal findings It is normal that the last experiment or series of experiments based on previous experience (Experiments 1-3 here maybe) is the conclusive evidence for any hypothesis.

Figure 3. Even more complicated developmental needs

5. It gets worse

Figure 4 shows an even more complicated story where considerable development is needed at all three experimental planning levels.
Assessment as to the effect of this progression has to be made according to the importance of the data being sort (the problem) as well as the support through continued funding and laboratory access.

4. It can be very messy indeed where many 'preliminary' experiments are needed to add modifications to achieve say experiment 4 data



4. Now we have three areas where development and revision was necessary. Again should be write up as though the methods (developed) were already established and give conditions only? This revision area causes problems with those newer to research. One way to avoid complications is to state that preliminary experiments were made to set up conditions. The exact time (sequence) when the experiments were done to achieve ideal conditions (say to allow Experiment 4) also causes problems. The logic of 1 to 2 to 3 to 4 may be obvious at the end of a series of experiments but maybe the development went through 3, 1, 2 then 4. If written up in this way the paper can be confusing. A paper is a culmination of work and not a proof that you are a genius and get things right straight away so it can be indicated that the achievements were made through trial and error and revision.

Figure 4. Even more complicated relationships as to progress of work

6. Complications

Of course it can be much more complicated where one is experimenting more into an area of science where there is little known or development is slight.

Here we may have to continuously revise and repeat experiments until more definitive data points the way to a conclusive result. Again this might be considered as all preliminary data and the degree to which such data is shown depends on its fundamental importance.

If you have achieved methodologies which are novel then the method per se can be summed up.

7. Time

What might not be reflected is the time taken to achieve this status.

It is important to get this over, particularly where finding bodies are anxious to see a return on investment.

The possible time needs to be reflected in plans.

The frustrations of research centre on not achieving success in time. If there is sufficient data to show 'promise' then this might be enough to produce a paper.

So write up in a logical sequence based on the importance of the findings irrespective of the sequence that you performed the experiments.

8. Further complications

You are not the only one involved in research.

There may be another publication involving your area of work which either beats you to a major finding, alters your perspective or provides data directly opposite to that you found.

Writing up then depends on:

How closely the work by others was to your own

Whether your methods offer advantages over others

Whether you have extra findings

Whether you consider that independent findings, reaching the same conclusions, value adds to knowledge.

Of course when you submit the editors may have differing opinions about work which is similar to others.

Despite good planning (we have to regard planning as a more dynamic process with some guesswork included) the experimental approach is always more complicated than envisaged.

Review **Figures 1** to **4** that illustrate the effects of having to revise and develop during research on time and effort and link this to writing up.

The effects are also examined with in the Planning Modules B01 and B02 from the pouint

of view of good research design

The figures took a fairly simple situation where the 4 experiments were considered.

Often there are more steps involved, each with risks and the need to adjust parameters based on data. The secret of good research is to identify as soon as possible, areas which cause problems and react in the most efficient way to solve or reassess needs.

This includes:

a. Drastic actions such as terminating the experiments altogether.

This might be imposed when deadlines set by funding agencies are not met.

b. Changing direction altogether as a result of your experimental data

A wise decision based on data.

c. Changing direction as a result of data received or published form other sources

A wise decision based on outside data.

9. Overview

To get a flavour of the complications which might be present in a project run by you only and then in a joint exercise, we can look at **Figures 5** which illustrates the pressures of time when extensive research development is needed.

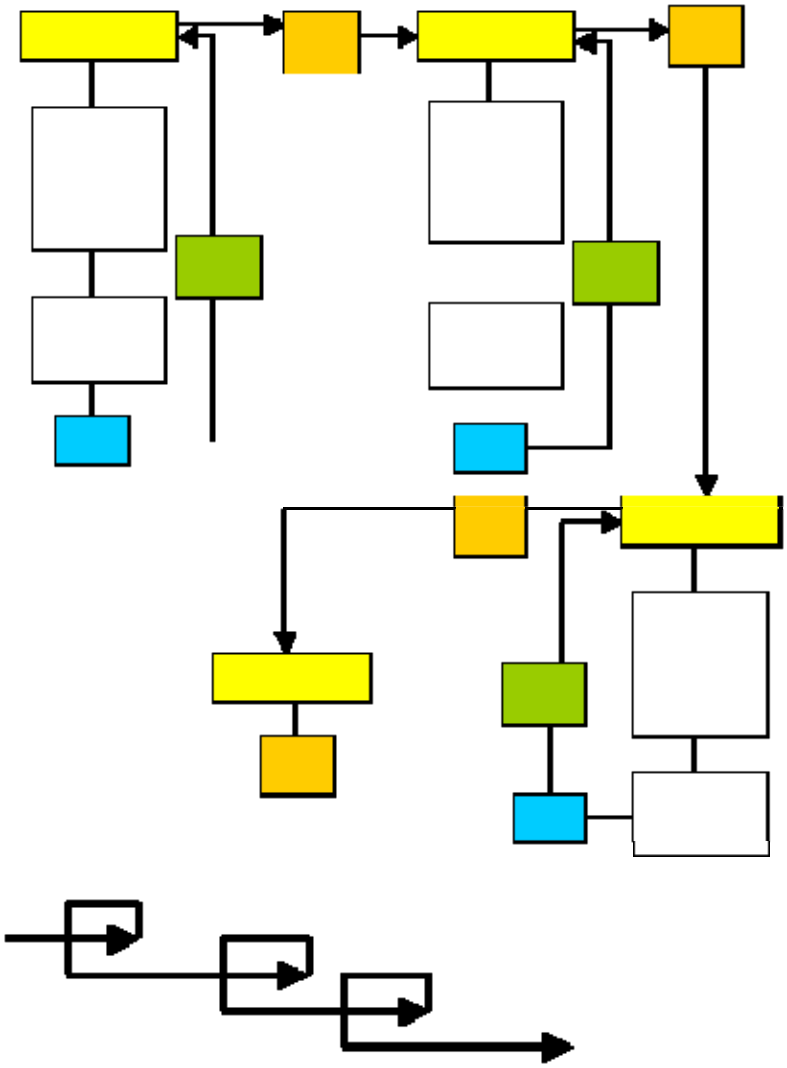


Figure 5. reminder of the flow of work where there is need to develop before each experimental stages 1, 2 and 3.

Figure 6 below shows the effects on development on achieving specified goals in your plans.

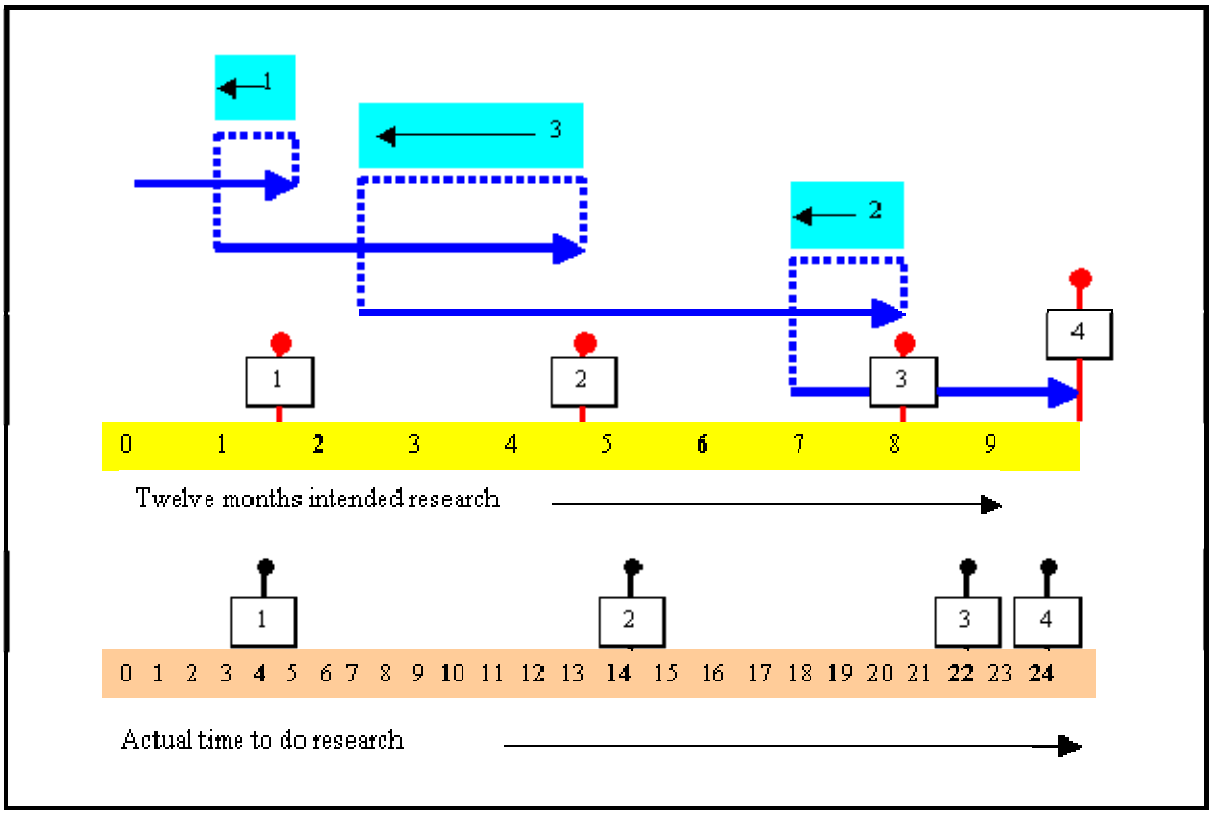


Figure 6. Time course for actual experiments involved in examining a problem (intended publication after 12 months) and planned time.

Lost time for development is shown in green boxes. The white boxes show the achievement of success in Experiments 1 to 4. The red vertical lines indicate the expected times (as judged in the yellow time bar) for the completion of the Experiments 1 to 4 as originally planned.

The actual time to do research is shown on bottom time bar.

Note that it takes twice as long as expected to do research.

Note also that once we have achieved Experiment 3, then the time is unaffected to achieve the required results. So publication of a methods paper if you stop at Experiment 3, will allow others to do rapid work and achieve good results in 2 months!

Note the time needed to get from experiment 2 to 3 is long. Here there may be problems in continuing research on this line (self imposed and outside pressure).

Resources for authors

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