11

Abstract: The Heart of Your Paper

The heart plays an essential role in the human body. Similarly, the essence of an article is its abstract. It goes to the core. *The heart has four chambers.* The abstract is also composed of four easily identifiable parts. *The heart always lives for the present.* An abstract is always written in the present tense to keep it fresh and current.

Visuals in abstracts?

Never say never! I used to think that abstracts had no visuals, but it looks as though I was mistaken. The tables of contents of some journals (e.g. *Advanced Materials*, *Journal of the American Chemical Society*) now include a key visual alongside an abridged abstract. Is this a preview of the shape of things to come for all journals? I believe it is. A good figure far exceeds plain text in illustrating and explaining a contribution efficiently and concisely. Therefore, take note and prepare yourself.

The abstract dissected in this chapter is at the crossroads between surgery and computer science. It comes from a paper on slit arteriotomy. The easiest way to explain it is to visualise anastomosis —

the surgical connection of two tubes (here, arteries). Normally, the surgeon cuts an elliptic hole (with removal of material) in the recipient artery and then stitches the donor artery over the hole. In this case, however, only a slit is cut in the side of the recipient artery before the donor artery is stitched over it. Consequently, there is no need to remove any material. Does slit arteriotomy work as well as hole arteriotomy?

Surgeons are (with good reason) very conservative: if a procedure (hole arteriotomy) works, why replace it with a new one (slit arteriotomy), even if initial statistics convincingly establish that the new technique is equivalent to the conventional one? To establish the safety and efficacy of the new technique, the surgeon who invented it asked for the help of computer-modelling scientists. The technique was modelled, and a paper was born. Its title was this:

> ***"Nonlinear finite element simulation to elucidate the efficacy of slit arteriotomy for end-to-side arterial anastomosis in microsurgery"***[a]

The title is composed of two parts: contribution and background. If you were to put a dividing bar | between these two parts, where would you put it? The answer will come later, after you have read the abstract. Note that the words in bold are common to both the abstract and the title.

> "[61 words] ***The slit arteriotomy for end-to-side arterial microanastomosis*** *is a technique used to revascularize free flaps in reconstructive surgery. Does a slit open to a width sufficient for blood supply? How is the slit opening affected by factors such as arterial wall thickness and material stiffness? To answer these*

[a] Reprinted from Gu H, Chua A, Tan BK, and Hung KC, "Nonlinear finite element simulation to elucidate the efficacy of slit arteriotomy for end-to-side arterial anastomosis in microsurgery", *J Biomech* **39**:435–443, 2006 (with permission from Elsevier).

questions we propose ***a nonlinear finite element*** *procedure to simulate the operation.* [10 words] *Through modeling the arteries using hyperelastic shell elements, our* ***simulation*** [112 words] *reveals that the slit opens to a width even larger than the original diameter of the donor artery, allowing sufficient blood supply. It also identifies two factors that explain the opening of the slit: blood pressure which is predominant in most cases, and the forces applied to the slit by the donor artery. During simulation, when we increase the donor artery thickness and stiffness, it is found that the contribution of blood pressure to the slit opening decreases while that of the forces applied by the donor artery increases. This result indicates that sometimes the forces by the donor artery can play an even more significant role than the blood pressure factor.* [28 words] *Our simulation* ***elucidates the efficacy*** *of the slit arteriotomy. It improves our understanding of the interplay between blood pressure and donor vessel factors in keeping the slit open.* [Total: 211 words]"[b]

The Four Parts of an Abstract

Each of the four parts in the abstract above (separated by the word count) answers key questions that the reader has.

Part 1: What is the problem? What is the topic of this paper?

Part 2: How is the problem solved (methodology)?

Part 3: What are the specific results? How well is the problem solved?

Part 4: So what? How useful is this to science or to the reader?

[b] *Ibid.*

A four-part abstract should be the norm. However, many have only three parts: the fourth one (the impact) is missing. Why?

1. Was the maximum number of words allowed by the journal reached too quickly because a long rambling start justified the importance of the problem, thereby forcing the author to skip or reduce a part?
2. Did the author (mistakenly) consider that the results speak for themselves?
3. Could it be that the author was not able to assess the impact of the scientific contribution, a result of the myopia caused by the atomisation of research tasks among many researchers?

Whatever the reason, having less than four parts reduces the informative value of the abstract and, therefore, its value to the reader. Since the reader decides whether to read the rest of your article or not based on the abstract, its incompleteness reduces your chances to be read and cited.

Before studying the abstract in greater detail, it is necessary to identify the author's contribution from the title of the paper. Where does the bar | separating the contribution from the context go?

> "*Nonlinear finite element simulation to elucidate the efficacy | of slit arteriotomy for end-to-side arterial anastomosis in microsurgery*"

In the abstract, the parts that cover the contribution should be more developed. In this abstract, they correspond to parts 2 through 4. Did you notice a discrepancy between title and abstract in this sample paper? There is one. If one evaluates the contribution by the number of words for each part, it seems that part 3, the elucidation

of the efficacy, is the contribution (112 words). Part 2, the nonlinear finite element analysis, plays an incidental role (only 10 words). The title could have been the following:

> *Elucidating the efficacy | of slit arteriotomy for end-to-side arterial anastomosis in microsurgery with a nonlinear finite element simulation*

However, after examining the structure of the paper (headings and subheadings), it appears that the contribution is indeed the nonlinear finite element simulation. The title is therefore correct. One concludes that the abstract is aimed at surgeons who care little about the technical details of the contribution, but more about the surgical method and its efficacy. Had the paper been targeted towards computer scientists, the methodology part would have been longer and the results part shorter. The readers of the *Journal of Biomechanics* in which this paper was published come from very diverse horizons. In both cases, however, the parts relative to the contribution contain the largest number of words (140–150 out of 211 words).

Read your abstract and locate its various parts. Does your abstract have its four essential parts? Are the parts with the largest number of words those corresponding to the contribution? Are you still using adjectives in the results section, or have you given enough precision?

Coherence Between Abstract and Title

A rapid calculation will determine whether an abstract is coherent with its title. In this calculation, articles, (*a, an, the*, etc.) and prepositions (*of, on*, etc.) are not taken into account. In the example above, 5 (41%) of the 12 significant title words are both in the title

and in the first sentence of the abstract. This percentage is good. Why? It really is a matter of common sense. Your title creates an expectation: the reader, having read the title, expects to know more about it as soon as possible. Can you imagine an abstract disconnected from the message of its corresponding title? It is unimaginable. The coherence between title and abstract is achieved through the repetition of words. Percentages outside the 30%–80% range should be examined more closely.

0%. There could be a problem. The first sentence deals with generalities loosely related to the topic of the paper. EXCEPTIONALLY, one sentence of background may be written to set the problem in its context. This is part zero of your abstract. Totally optional, it should be the exception, not the rule. In any case, it should at least contain one word from the title.

20%. The first sentence contains one or two title words. It sets the background to the problem, or briefly explains one or two unusual title keywords. This is fine, as long as sentences 2 and 3 mention most of the other title words. Otherwise, the background is too long and, as a result, the abstract lacks conciseness.

90%–100%. Idyllic percentage? Not necessarily. The first sentence is often a straightforward repetition of the title with just a verb added. Why repeat? The first sentence should expand, not just repeat, the title. However, if it contains many more words than the title, then 100% may be acceptable.

To summarise, the first sentence of your abstract should contain at least one third of the words in your title (these words are frequently found in the second part of your title, i.e. its context). Your title merely whets the appetite of your readers; they expect to know more about your title in your abstract. You should satisfy their expectation and rapidly provide more precise details.

First, count the total number of significant words in your title (do not include small words such as *on*, *the*, or *a* in your count). Let's call this number *T*. Then, identify in your first sentence the significant words that are also in the title. Underline these words IN THE TITLE. Modified forms (a noun changed to a verb or vice versa) are acceptable, but synonyms are not. For example, *simulation* would be considered the same as *simulated*, but *abrasion* would not be the same as *corrosion*. Count the number of words underlined in your title. Let's call this number *U*. Finally, calculate the percentage $100 \times U/T$. What is your percentage? Between 30% and 80%, you are doing fine. Outside of this range, investigate.

A second calculation will help you identify the strength of the cohesion between abstract and title. Are ALL title words also in the abstract? They should be. Think about it. You give high visibility to a word by giving it "title" status — the highest status in a paper. Why would title words be missing in the abstract? It may be for the following reasons:

1. You used the synonym of a title word to avoid repetition. Why? By doing so, you miss out on a great opportunity to reinforce the message communicated in the title. Repeating a title word in the abstract will also increase the relevance score calculated by search engines for that keyword. As a result, your title will be brought up towards the top of the list of titles retrieved. Using an alternative keyword is acceptable only if two keywords are interchangeably used in your field. The alternative keyword would then increase the probability that your title is found by search engines.
2. The title word is not important. Remove it from the title to increase conciseness.

3. The title word missing in your abstract is really important. Find a place for it in your abstract.
4. It may, also be that your abstract contains a keyword that should be in the title, but is not. In that case, rewrite your title to incorporate that keyword.

You have already calculated *T* the number of significant words in your title. Read your abstract and see if any of the important title words are missing. If some are, ask yourself why. It may be that your title claims are too broad, your title is not concise enough, you are using synonyms that dilute the strength of your keywords and confuse the reader, etc. Decide which reason applies, and modify the title or abstract if necessary. If you are yet to write your first paper, use the sample abstract (arteriotomy).

You now have four techniques to gauge the quality of your abstract.

1. Abstracts have four parts. The part that represents your contribution should be the most developed.
2. Abstracts repeat their title words in full. (A possible exception to this recommendation is when you use alternative keywords because a particular concept is expressed by two equally probable keywords and you want your paper to be found/retrieved. You then use one keyword in the title, and the other equally probable keyword in the abstract.)
3. Abstracts expand the title in the first two or three sentences because the reader expects it.
4. Abstracts need to set the problem, but do not need to justify why it is important (the introduction does that). They need, however, to justify the significance of the results (*a posteriori* impact).

The Tense of Verbs in an Abstract

An abstract is about what you do NOW! Consequently, use ONLY the PRESENT TENSE when writing the abstract. There are added advantages to doing this. The present tense is vibrant, lively, engaging, leading, contemporary, and fresh. The past tense is passé, déjà vu, gone, stale, unexciting, and lagging. It feels like reading old news. The researcher has finished a Herculean task and describes it without excitement, as a thing of the past. Furthermore, the past tense can create ambiguity. For example, the phrase *was studied* creates doubt: did the writer publish this before?

Purpose and Qualities of Abstracts

Purpose of the abstract for the reader

1. It makes the title clear.
2. It provides details on the writer's scientific contribution.
3. It helps the reader decide whether the article is worth reading or not.
4. It helps the reader rapidly gather competitive intelligence.
5. It helps the reader assess the level of difficulty of the article.

The abstract is NOT to be used for the following:

1. To mention the work of other researchers (it is the role of the introduction), except when your paper is an extension of a (one) previous paper, yours or that of another author.
2. To justify why the problem you have chosen is important (it is also the role of the introduction). Your abstract should concentrate on the importance of the results, not that of the problem.

Purpose of the abstract for the writer

1. It allows the paper to be found more easily, because it has more keywords than the title.
2. It states the writer's contribution in more precise detail than the title (adjectives in the title are frequent, but they should be rare in the abstract).

You could also write two abstracts: one put together before starting your paper to capture the gist of the contribution, and the other written after your paper is complete to capture the heart and soul of the paper. The two may differ, for they serve different purposes: one guides, the other summarises.

Qualities of an abstract

An abstract is **COMPLETE.** It has four parts (what, how, results, impact).

An abstract is **TIED TO TITLE.** All title words are found in the abstract.

An abstract is **CONCISE.** It is not longer than necessary, as a courtesy to the reader. Justification of research is best done through significant results.

An abstract is **STAND-ALONE.** It lives by itself in its own world: databases of abstracts, journal abstracts. It needs nothing.

An abstract is **REPRESENTATIVE** of the contribution of the paper. It sets expectations for the reader.

An abstract is **PRESENT.** Real. News.

Not all abstracts have four parts, sometimes with good reason. A review paper that covers the state of the art in a particular domain has only one or two parts. Short papers (letters, reports) have one or two lines. "Extended" abstracts are written prior to a conference, in some cases before the research is even completed; as a result, their parts 3 and 4 are shallow or missing. But, apart from these special cases, all abstracts should have four parts.

What do you think of your abstract? Does it have enough of the qualities mentioned here? Is the contribution you mention in your abstract consistent with that claimed by the title? A quality abstract makes a good first impression. Spend some time reviewing it.