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How to write a coherent research paper

Arthur Bakker,
Utrecht University
a.bakker4@uu.nl
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Writing a coherent research paper is quite a challenge. The good news is that it can be learned by following a few guidelines. This manuscript first addresses what is meant by coherence and why it is important. Its main part provides hints how to improve different types of coherence and at different grain sizes (section, paragraph, sentence and word level). The intended audience includes Master and PhD students who have to write an educational research paper, but many guidelines are so general that a wider audience may benefit as well.

1. Coherence

1.1 What is coherence?

What is interesting is that a lack of coherence is much more apparent than coherence itself. Do you recognize any of the following feedback on your texts?

Table 1.

Common Feedback Related to a Lack of Coherence

- This comes out of the blue (Dit komt uit de lucht vallen).
- What is the line of reasoning exactly? (Wat is de rode draad? Het kan strakker.)
- What is the focus of your paper?
- What has X to do with Y?
- What is your main message?
- Do you really need this concept/theory/passage?
- Your goal and research question are not really in line
- Your research question is not really answered
- Are the subquestions really helping to answer the main research question?
- How is this study related to the bigger project?
- You do not refer to all figures/tables
- There are missing references and references you do not cite in the text.
- What does 'this' refer to? What is this issue/this research?

All these questions and comments refer to some lack of coherence. Some refer to missing links at the micro or sentence level (what does the word 'this' refer to?), while others have to do with the macro level or overall structure of the paper. Some questions have to

do with references within the text; others with the logic of the paper. In the main part of this manuscript I classify different types of coherence. But let's first answer the question: What do we mean by coherence? Dictionaries state something like the following: Forming a whole that fits together. Your writing is coherent if everything is logically layed out and connected (wiki.answers.com). Coherence leads to continuity (flow): Some papers read seamlessly from the first sentence to the last because all information is concisely formulated and all connections are aptly expressed.

Coherence is also related to cohesion and consistency. Cohesion is the force that holds elements together. In linguistics (Halliday & Hasan, 1976), cohesion refers to textual links that hold a text together. These include referencing (e.g., "this", "the aforementioned"), leaving out unnecessary information, substitution ("it" instead of repeating a noun), conjunctions ("and"), and transitions ("however", "consequently"). Where cohesion refers to textual elements, coherence refers to the ideas expressed. A text can therefore be cohesive (with appropriate references and transitions) even though the ideas are not really coherent (what is announced as the answer to the research question is not really a satisfying answer). Vice versa, ideas can be connected logically even though the connections are not very well expressed textually (a satisfying answer is given but not announced textually as the answer to the research question). Students who try to use cohesive markers sometimes exaggerate; the risk then is that there are words such as "however" in sentences that are not really a contrast with what was written before.

Consistency refers to the absence of internal contradictions. A coherent paper is consistent, but a consistent paper need not be coherent. For example, information may be redundant, which would make the paper less coherent but not less consistent.

1.2 Why is coherence so important?

Educational research has shown that people find it easier to read a coherent text than a less coherent text and they better remember what the text is about (Kamalski et al., 2008; McNamara et al.; Sanders et al., 2007). Thus a coherent text communicates your message better than a text with some missing links. It is therefore not surprising that coherence is something that editors, reviewers and supervisors look for. A lack of coherence is easily spotted and often criticized.

I once sat next to two students, J and N, who read each other's introductions to research proposals. N could easily summarise J's proposal, whereas J complained she did not really know what N's proposal was about. "It is odd how some texts are easy to follow. I don't know what causes that." Surprise, surprise; this has to do with coherence.

A coherent text helps to focus on what it is about. Ideas are easy to follow and links are as expected or logical: The text is transparent. The spectacles metaphor can illuminate this notion: When our spectacles are dirty, we are distracted; we see the glasses themselves (Roth, 2003). But once we can see through them they help us see something outside and we do not notice the spectacles anymore. This is why a coherent text mostly does not draw any attention: We can focus on the content instead. We are not disturbed by missing reasoning steps or unclarity what the authors are talking about.

1.3 What makes a text fit together?

Based on Brandom's (2000) semantic theory of inferentialism, I distinguish two types of relations that keep ideas and texts together: inferential and referential relations (see also Bakker & Derry, 2011). Inferential relations have to do with logic and reasoning. Referential relations link something in the text to something else in or outside the text.

Table 2

Examples of Inferential and Referential Relations.

<i>Inferential relations</i>	<i>Referential relations</i>
<ul style="list-style-type: none">• Question – answer• Premise – conclusion (if – then)• Goal – achievement• Means – end• X is a reason for Y• After X one expects Y• X is necessary information to understand Y	<ul style="list-style-type: none">• Reference to a larger project or field of research• Reference to another publication• Reference to table or figure• Reference to something in the text (problem, challenge, section, demonstrative pronoun such as 'this')

Inevitably, when we make such distinctions there are also boundary cases in which a relation can be both inferential and referential. Let's start with the inferential relations, because they are the most important and difficult type of 'glue' that makes papers fit together.

2. Guidelines for improving inferential relations in your paper

2.1 Focus

Focus is very important for a paper: The text has to be at the service of one main message that the reader can remember and tell somebody else in the one-minute lift chat.

Guideline 1 (G1): Try to summarise the main message of your paper in 12 to 16 words.

Do not rest until you have one focus. If you have two goals, try to see if one is the service of the other (e.g., identify problems is at the service of identifying potential solutions). The most common criticism in reviews I have seen is that the focus is not clear or not consistent. A good way to check the focus of your paper is to highlight all sentences that could be interpreted as indicating the focus: title, core sentences in the abstract, and sentences that capture the aim, research question or conclusion. Then read all highlighted text in one go to see if all these sentences are consistent.

2.2 Identify the main research function

A research project has a main function, for example to

- describe or define
- compare

- evaluate
- explain
- advise

It is very common for research projects to have phases with different functions (one of which can be to design such as in design-based research). Oftentimes, it is necessary to describe a situation before it can be evaluated, and to evaluate before advice for improvement can be underpinned. The main research goal is then to bring out advice – the other phases are at the service of this higher goal. In such a case, the research question is typically evaluative.

Research questions should reflect the research function otherwise your text is inconsistent at this point.

- To describe (e.g., what conceptions of sampling do 7th-grade students have?)
- To compare (e.g., does method A lead to better test scores than method B?)
- To evaluate (e.g., how well do students develop an understanding of distribution in this instructional sequence?)
- To explain or to predict (e.g., why do so few students choose a bachelor in mathematics or science? What will students do when using a particular software package?)
- To advise (e.g., how can secondary school students be supported to learn about correlation and regression?)

For example, a ‘what’ question is typically descriptive. Evaluative questions often include something like “how well”. Explanatory questions can generally be recognized by formulations such as “why” or “how can X be explained”. Advice questions often start with “how should...?” or “what is a good/the best way to...?”

G2: Identify the main research function addressed in your paper and ensure that the formulation of your question is consistent with this function.

Sticking to such conventions helps the reader to identify the type of research carried out, and foresee the kind of research methods used. What I sometimes see is a research question that is formulated in a descriptive way, but where the context clearly suggests that the researchers really want to evaluate or give advice.

2.3 The chain of reasoning in a paper

Each research project has a particular logic and a paper about it should reflect this logic. For example, you might address a particular problem and propose a potential solution. The research project’s goal is to test if your idea works, so you have a hypothesis or a research question on some specific aspect of the potential solution (say a teaching strategy). You apply particular research methods to test the hypothesis or answer your question, which leads to results. These are then summarised and discussed in the final

section, where one also reflects on how well the question was answered and what are the implications of your findings. A useful document on the chain of reasoning is Plomp (2010); see Figure 1 for a visual overview.

G3: Make a one-page outline of your paper's chain of reasoning to check if it makes sense.

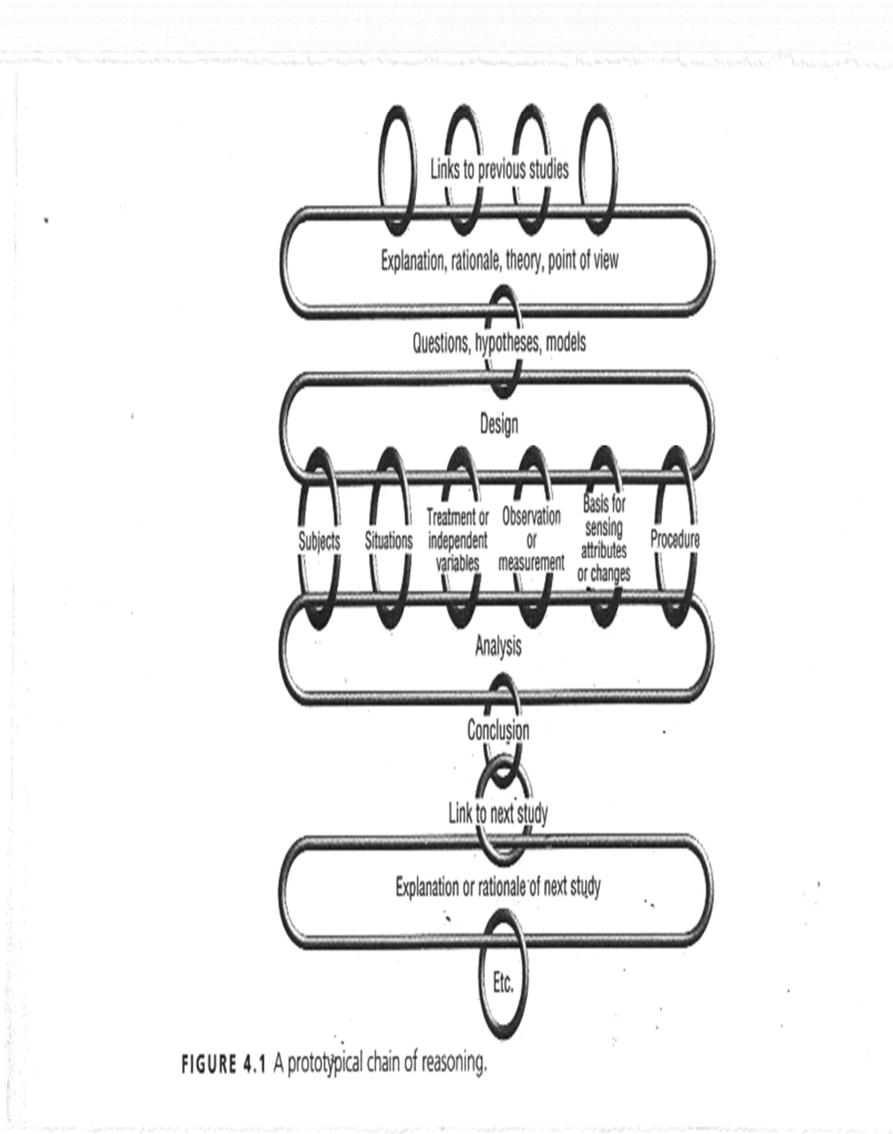


FIGURE 4.1 A prototypical chain of reasoning.

Figure 1: Chain of reasoning for research (Krathwohl, 1998; chapter 4)

2.4 The general 'shape' of a paper

The general shape of a research paper can be visualised as zooming in and out. The start of a paper should be broad enough so as to seduce readers into your topic (zooming in), except if your first sentences state the purpose of your paper. How broad you start depends on the scope of the journal or the audience. If you write for a special issue on a particular topic, there is no need to start much broader, but if you write for a general educational journal, you might need to speak to a wider field before you zoom in to your specific subfield or topic. You relate your work to that of others and identify the knowledge gap.

The narrowest part of the paper is the methods and results sections, which are specific to your own project. In the results section you do not (or hardly) refer to other people's work.

In the discussion you zoom out again and relate to the broader field of study. Implications for practice and limitations of your approach are discussed (zooming out). You relate your findings to the work of others or future research to be done. For a feeling of closure, it is worth trying to return to the title or topic of your first paragraph. This gives the reader a sense of the text being a whole.

G4: Ensure that your paper starts broad enough. Zoom in on the knowledge gap and your goal or research question. In the discussion you zoom out again.

For advice on each section of a paper see Wallwork (2011) but note that he wrote for other disciplines than education.

2.5 The logic of introductions

There are two common shapes for introductions: the funnel (start of the aforementioned zooming in) and what I call the reverse pear (see Figures 1 and 2).



Figures 1 and 2: funnel and reverse pear

The funnel shape introduction involves the following steps:

1. introduction of an interesting topic or problem (the reader needs to be convinced of the practical and/or theoretical relevance of the paper)

2. narrow down to a specific aspect or potential solutions (zoom in)
3. identification of a knowledge gap; formulation of purpose, hypothesis or research question of the paper (identify or carve out your niche: convince the reader that it is necessary to find an answer to your question)
4. description of what the reader can expect (this is not really necessary if the paper follows the standard format of empirical research papers).

In medium-sized papers of about 6000 to 8000 words, the introduction is typically about four paragraphs (*alinea's*) – one for each step. If you need to discuss why a solution or instructional idea did not quite work and why you will try something else, you might need an extra paragraph.

The reverse pear is almost the same except that it starts with the purpose of the paper – the top of the reverse pear, after which the funnel starts. The advantage of such a start is that the quick reader immediately knows that the paper is about, which is important in times when people read a lot online and are always in a hurry (cf. Wallwork, 2011, Chapter 4). However, this approach can only be applied if the concepts used to describe the purpose need little explanation. If you need to explain technical concepts, it might be necessary to introduce these before the purpose can be stated.

G5: The function of an introduction is to convince your readers of the relevance of your topic, the need to fill a knowledge gap and to narrow down to the purpose of your paper. The purpose of your paper is typically the end of the funnel.

Table summarises advice on how to structure your introduction (Swales & Feak, 2004, p. 244). Wallwork's (2011) book is also accessible and provides excellent hints. Each chapter can be downloaded from the Springer website.

Table

Move	Explanation
1	The authors' establish a research territory <ol style="list-style-type: none"> a. by showing that the general research area is important, central, interesting, problematic, or relevant in some way (optional). b. by introducing and reviewing items of previous research in the area (obligatory).
2.	They then establish a 'niche' by indicating a weakness in the account so far by indicating a gap in the previous research, raising a question about it, or extending previous knowledge in some way (obligatory).
3.	They then occupy the niche by saying they are going to put this right <ol style="list-style-type: none"> a. by outlining the purposes or stating the nature of the present research (obligatory). b. by listing research questions or hypotheses to be tested (optional). c. by announcing the principal findings (optional).

2.5 Only introduce what you need

The Russian playwright Anton Chechov is well known for his one-liner: “One must not put a loaded rifle on the stage if no one is thinking of firing it”

(http://en.wikipedia.org/wiki/Chekhov's_gun). In other words:

G6: Only introduce elements (concepts, theory) that you will need to position your research, clarify key concepts or analyse your data. Otherwise you raise expectations you cannot fulfil.

Students often feel the need to show they know the theories or concepts used in a particular area. Or they identify knowledge gaps that are not filled in this particular paper. If you identify something in your introduction that is unsolved or unknown, the reader will expect your paper to contribute to a solution.

3. Guidelines for improving referential relations in your paper

3.1 Relations with a larger project

One of the key challenges for PhD students is to “cut up the elephant” (an expression I first heard from Albert Pilot). Unless a research project is split into well-defined smaller studies, it can be hard to demarcate what should be addressed in a single paper and what should be left out. This challenge is especially prominent in design-based research and large projects with many facets. Think carefully how you phrase the goal of the larger project and, in relation to that, the goal of the specific study you report on fits into the bigger picture.

3.2 Relations with sources outside the text

Vary terminology?

A common source of confusion is that authors use different terms for the same thing (e.g., instructional materials, educational sequence, module, unit). My advice is (see Wallwork, 2011, Chapter 4):

G7: Vary words that are not technical (especially within one paragraph), but stick to the same word for each technical or scientific object of interest.

Hence it is fine to use synonyms for terms such as importance (value, need, requirement) but if your paper is about an educational unit, use the same term consistently throughout your text. Otherwise readers might think you mean something different as soon as you use the term module or sequence. If you use the word ‘purpose’ in your introduction use the same word again in your discussion: If you use synonyms like ‘goal’ or ‘aim’, readers will have to do an extra thinking step or might even wonder for a second whether you mean something else than in the introduction.

3.3 Relations within the text

Relations within the text might sound rather trivial. Yet flaws in this area are common.

References to sources of information

1. Make sure you refer to all figures and tables in the text.
2. Make sure your list of references is complete and all references are cited in the text. If you do not use a bibliography program such as RefWorks or Endnote, you can check this by using the find function in Word to check all “in press”, “20”, “19” etc. in your text and tick the references you find on paper. This helps you find all missing references and identify references not cited in the text.
3. If you refer to a section, make sure you use the right number or title of the section.

References at the sentence and paragraph level

Wallwork (2011, chapter 4) explains how you can ensure that one sentence links with the next. Sentences start with a topic and end with the focus on what you want to write about it. This focus becomes the topic of the next sentence. The end of a paragraph should link with the start of the following paragraph. If you are tempted to copy + paste text from other positions, ensure that links with the surrounding text are restored. In my experience, this mostly requires full rewriting of what was copied + pasted initially.

G8: Avoid copy + paste, because it mostly leads to incoherent texts. Flow is best achieved by writing without interruption.

One of the most common flaws in referring is the use of demonstrative pronouns such as ‘this’. Whenever you use or read this word, ask yourself: Is it clear what it refers to?

<i>Not recommended</i>	<i>Recommended</i>
- ... (reference to an article). This research ...	+ ... (ref). The research reported in this paper...
- A common issue in education...	+ A common problem/challenge/concern in education...

In the first example, the use of the word ‘this’ is interesting because it mostly refers to the author’s research, not to the aforementioned research cited in the reference. To avoid confusion you could write something like this: “the research project reported in this paper”. The APA guidelines also advise to use I or we (my, our...) to make references clear. Another advantage of I and we is that it is easier to use the active voice. Note, however, that “we” typically refers to the authors, not to some vague general “we,” because it is often not clear what this “we” refers to: author and reader together, society, or people in our discipline?

5. Discussion

The reader might wonder whether coherent and good are synonyms. That is at least a question I often hear. My answer is, they are not. A coherent text can be superficial, too limited or without enough substance. A good paper can have some flaws in coherence, which can be compensated by depth, quality of the research, interesting results or implications of the ideas presented. Another question often asked is: What if an

interesting idea does not totally fit the goal or research question? When aiming for coherence, the answer is: Leave it out and try to get this idea across in another paper. However, we have limited time to write papers or we may lack empirical data to justify another paper on the same topic. One solution is to weave your idea into in the discussion section of your paper because this is the place for generating hypotheses and potential explanations.

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