

## Review for *Normal Science vs. Extraordinary Science*

### *Some general comments:*

- I like your title. It's short, to the point, and it tells me what your paper is about.
- Formatting: Professor Kaplan specified size 12 Times New Roman with 1 inch margins as our formatting requirements. I am fairly certain that your margins are more than 1", so you might want to change this. I find that justified margins give a more professional appearance, but of course that's a matter of personal preference.
- Citations: None of your quotes are cited, either with page numbers or authors. This is particularly important given that you are (I believe) quoting text from multiple sources. Even when you are not quoting directly, you still need to cite information that you are taking from someone else's work. Failing to cite your sources is considered plagiarism, so I would recommend you add citations, either as footnotes or as parenthetical references with a bibliography.
- Commas: There are a number of places in which either you use commas incorrectly, or don't use them when you need to. The most common error arises when you omit commas around prepositional phrases; for example, there should be a comma after the phrase "To Popper," which you use a number of times throughout your paper. Also, commas are not always necessary immediately before a quotation. This depends on how you introduce the quote, so there isn't a strict rule. Omit the quotation marks and read the sentence - if you don't need a comma without the quotes, you don't need a comma with them.
- Prepositions: You end a lot of sentences with prepositions. This isn't grammatically correct. It's usually fairly easy to rearrange the sentence to fix this problem.
- Wordiness: You include a lot of extraneous phrases. Try to make your writing more concise by omitting these extra words; this will also help you get to your point faster. For example, phrases such as "really just boils down to" (page 2) and "which has now been around for" (page 3) can be replaced with something more concise, or even omitted entirely. The "extraneous phrase" category also includes repetitive words and phrases. In your introduction, you use the words "normal science" four times in three sentences, and on the second page you refer to a "young bold new scientist." Both of these instances are excessively wordy. Read through your paper and see where you can take out words without hindering your meaning.
- Proofreading: You have a lot of typos and other editing oversights. Also keep an eye out for run-on sentences. I'm not going to give examples, but proofread your work.
- Informality: There are several places in which your language or punctuation is informal. Parenthetical notes are informal - if what you have to say is important, don't relegate it to parentheses, and if it isn't important, don't say it at all. Also, you put words in quotes a lot. Since you haven't cited your quotations, I'm not sure whether these are quotations from other sources or simply you putting quotes around selected words. If these are quotations from another author, you need to cite them. If you're putting quotes around words, this is another case of informality. It makes your intended meaning ambiguous, and it makes your writing sound colloquial.

### *The Introduction*

- Compare the starts of two of your sentences: "In Thomas Kuhn's novel The Structure of Scientific Revolutions, he explains in depth..." and "In his piece The Danger of Normal

Science, Karl Popper refutes...” In the second sentence, removing the prepositional phrase leaves you with “Karl Popper refutes...,” which is a perfectly clear sentence. However, removing the prepositional phrase in the first sentence yields “He explains in depth...,” with “he” as an ambiguous subject. You should clarify this sentence.

- You state that “it is this normal science that provides a framework for experiments to run in.” However, I think that this is closer to Kuhn’s definition of a paradigm. Kuhn defines normal science as “research firmly based upon one or more past scientific achievements” (10). So according to Kuhn, normal science is the research that is conducted under a paradigm.
- Is Popper’s work a book? An article? Whether it should be underlined or punctuated in some other way depends on the format.
- You don’t ever state explicitly the definition of normal science or of extraordinary science; given that your paper focuses on these two concepts, I think it is important to do so. If you don’t, you will leave your readers wondering what it is that you are comparing.
- You state that “a paradigm predicts the answer to a puzzle.” However, I don’t think this is an accurate assessment. Kuhn suggests that scientists conduct experiments for which they know there *are* answers. This is very different from knowing *what* the answers are. It is quite easy to devise an experiment whose outcome is unclear; it is much more difficult to design an experiment to answer a question if we don’t know whether or not the question is answerable.
- Be wary of suggesting that revolutions arise from mistakes. The word “mistake” implies that an experiment was conducted improperly - if this is the case, there is no need to throw away the entire paradigm, only to repeat the experiment and correct the error.
- Your thesis confuses me. I think what you are ultimately trying to say is that you disagree with Popper, and agree with Kuhn; normal science is necessary for scientific progress. However, the sentence is very ambiguous. You say that Popper “does not realize” the importance of normal science. Given that Popper has put a great deal of thought into forming his own scientific philosophy, I doubt that he has developed a theory that does not allow for any scientific progress whatsoever. What do you mean by “without normal science nothing would get done”? Do you mean that new scientific discoveries cannot be made without normal science? What about the first paradigm - the initial paradigm in any field did not arise from a period of normal science, but the formation of a paradigm represents a definite accomplishment.

### *The Body*

- The first sentence of your first body paragraph is a bit ambiguous. I can’t tell whether you’re listing normal science, Kuhn’s concept, and extraordinary science as three concepts, or if you’re trying to state that normal science is Kuhn’s concept, but extraordinary science is not. Clarify this.
- Kuhn spends considerably more than a chapter discussing normal science. Furthermore, I don’t think it’s quite relevant how much of his book he devotes to a concept - you’re addressing normal science in your paper, and it doesn’t become a more important issue if Kuhn spent more pages discussing it.
- You say that normal science “lays a baseline for scientist to experiment on.” Apart from the grammatical errors in this sentence, as in your introduction, this sounds more like a paradigm than normal science to me.
- In both paragraphs on the second page, you suggest that revolutions arise from entirely new ideas, which come out of nowhere. Kuhn’s proposal makes no such statement. Instead,

Kuhn believes that revolutions occur when anomalies are observed in the current paradigm. These anomalies can only be discovered if scientists are conducting research under the paradigm. You imply that revolutions occur when someone decides to work outside of a paradigm.

- “Little” is a weak word, as is “things” in the next paragraph. Consider using something else.
- Towards the end of the first body paragraph, you say “along the way.” Along the way to what? Is there a final truth to which these revolutions lead?
- Why would normal science be boring for scientists? What was the context of the quote “the normal scientist has been poorly taught”? It seems to me that it would be very easy to use this quote out of context, and lead your reader to believe that Popper wrote something that he actually did not. I’m not implying that you’ve done this, but be careful that you don’t give that impression.
- You state that a scientist “solves puzzles but fails to questions reasons why.” I would argue that a great deal of scientific puzzle-solving *is* asking why. Data collection is usually the easier part of an experiment - the challenge is analyzing the data to determine why a certain phenomenon resulted.
- The second paragraph on the second page essentially implies that scientists are lazy. You state that it’s easier to experiment under a paradigm than not, and so Popper’s explanation doesn’t work because it is too difficult. Suggesting that scientists follow the easy course rather than a more difficult path that may be more fruitful is probably not the best method of persuasion.
- Near the top of the third page, you say “this equation would in the field...” Consider using a different verb tense; “would” implies doubt, while I think you are asserting that the equation *is* a revolutionary idea.
- Is the start of a field a revolution? Kuhn’s model can be represented as a loop: paradigm, normal science, anomaly, new paradigm. But the start of a field is an alternate route to the “paradigm” stage - it is a pre-paradigm →paradigm shift, and I don’t think this qualifies as a revolution, according to Kuhn.
- I am not sure the statistic you give about the length of time quantum mechanics has existed is relevant. Why would you expect a new revolution to occur over an 80 year period? Maybe it is simply the case this field has arrived at a truthful paradigm. Is there a certain frequency with which you would expect an anomaly to be observed?
- You state that “evolution is another contradiction to Popper’s theory of extraordinary science and in turn of Kuhn’s ideas.” I think your wording here is confusing - your sentence suggests that evolution contradicts both Popper’s theory *and* Kuhn’s theory, while I suspect you mean that it refutes Popper and supports Kuhn.
- You say that Einstein published *On the Origin of Species*. I presume you mean Darwin.
- Don’t say that a discovery provided proof for a theory. Scientific theories cannot be proved; they can be demonstrated. Experiments provide support for theories, but they don’t *prove* them.
- Twice in this paragraph you imply that scientists are trying to disprove Darwin’s theory. Before I got to the sentence “Scientists have not been working to overturn this theory...,” I was quite confused. My initial reaction was “well of course nobody has disproved evolution - we aren’t trying to!” Then I realized that this is precisely your point - which is why

Popper's suggestion is not right. But your wording confused me initially, so you might want to consider rearranging some of your sentences so your meaning is clearer.

- Don't refer to the course in your paper. Just because we couldn't think of an answer doesn't mean that there isn't one. Even if there is, referencing our class discussion makes you sound less professional.
- Your sentence that begins "For example Dawkins..." is unclear. I don't know what you mean by the phrase "which what could be called," and you should have two words of the same part of speech instead of "cultural/idea" - here you have an adjective and a noun.
- I'm not sure it's relevant to discuss Dawkins' notion of a meme. You're analyzing whether evolutionary biology fits Kuhn's model or Popper's model - neither author addresses extrapolation of a paradigm to other fields.

### *The Conclusion*

- When you say that "the fields of science all work under an overall paradigm," do you mean that science as a whole has a paradigm, or that each scientific field has its own paradigm? This sentence is ambiguous.
- In the same sentence, you say "them" twice. Each time, I think you mean the scientists, but the way you have written your sentence, "them" actually refers to "the fields of science" in both cases.
- Why wouldn't science get anywhere without normal science? I don't think you've addressed this point sufficiently. You've discussed why Kuhn's model is more accurate than Popper's in describing how science actually has progressed, but not why Popper's model would be unsuccessful.
- Your thesis states that Popper thinks normal science is dangerous. You make this assertion again in your conclusion, but you don't discuss in your paper why normal science is dangerous.

### *A final general comment*

Although Kuhn and Popper both address the same general topic of how science is studied, there is an important difference between them. Kuhn examines the history of science, and Popper studies the philosophy of science. In other words - Kuhn's model is based upon what history has shown. He looked at previous scientific revolutions, and based upon these revolutions, formed a theory for the pattern that scientific revolutions follow. Popper, on the other hand, is purely a philosopher. He is not trying to explain how science *does* work; he is proposing a theory for how it *should* work. Popper thinks that scientists *should* experiment outside of a paradigm, not that they *do*. This is an important distinction because it changes the lens through which your paper is read. In order to have a cohesive paper, once you've established that science does indeed follow Kuhn's model, you need to examine whether science should continue to follow this model, or if it should switch to Popper's model. The core of your argument still holds, but it would actually be a much stronger argument if you focus more on what science should do and less on what it actually does.