Revising for organization within paragraphs

Key points:

- Signal what a paragraph is about at the beginning
- How to make your paragraphs signal
    - Write according to a plan
    - Revise using note cards
        - Purpose of paragraph on the front, first sentence on the back
        - If they don't match, revise the first sentence or reconsider which sentence should be first
- Paragraph structure depends on content
    - Message in first sentence okay if acts as transition
    - Message at end if evidence must be given first
    - Order sentences within paragraph according to some consistent logic

Signal what the paragraph is about at the beginning

Have you ever arrived at the middle of a paragraph and realized that you're not sure where it's going or what it's about? This might happen if the paragraph is scattered and jumps from one topic to the next and back, but if all the sentences are about one thing, you might still get confused if the writer doesn't clearly indicate what that thing is at the beginning. As you begin reading a paragraph, you (perhaps subconsciously) form an idea of what the paragraph is about, and if the first couple of sentences don't state that, you'll likely come up with something other than what the author intended. Consider:

Example 1: No indication of topic

Ablation of key sensory neurons in the nematode or mutations that result in their loss of function can modulate lifespan, with some neurons limiting lifespan and others promoting it [6],[7]. In the fruit fly, *D. melanogaster*, a loss-of-function mutation in Odorant Receptor 83b (Or83b), which broadly reduces olfactory capabilities, produces a significant increase in stress resistance and lifespan [8]. Fat deposition is also altered in these mutant flies, suggesting that olfaction may impact global energy balance [8]. Furthermore, expression of the transcription factor skn-1 in two sensory neurons in *C. elegans* is required for reduced nutrient availability (also called *dietary restriction*, which increases longevity) to affect nematode lifespan, albeit that this effect seems to be independent of environmental sensing [9]. Even temperature may modulate worm aging at least partially through its activation of thermosensory neurons [10].

From Poon PC et al., *PLoS Biol* 8(4): e1000356. doi:10.1371/journal.pbio.1000356

Based on the first sentence, you might think that the paragraph is about the effects of loss of function of sensory neurons in *C. elegans*. Once you get to the second sentence, you realize that the topic is broader than that, since it's still about sensory function, but no longer focused on neurons or worms. Only at the end can you deduce from the multiple mentions of "lifespan" that the paragraph lists evidence

indicating that sensory input regulates lifespan. Once you arrive at this conclusion, you may even need to go back to the beginning to interpret the first few sentences in this light.

Clearly, paragraphs that dive right in rather than signaling to the reader what they're about require a lot of effort on the part of the reader. The approach many have learned to signal the purpose of the paragraph is to begin with a topic sentence. This phrase likely conjures a dull, encyclopedia-like introduction to a paragraph like "The hypothesis that sensory input regulates lifespan is supported by several pieces of evidence in both *C. elegans* and *Drosophila*." However, a sentence signaling the point doesn't have to be so dry, so I hesitate to use the phrase "topic sentence." The example paragraph actually began "Perhaps most remarkable has been the discovery that aging itself can be subject to neurosensory regulation. Indeed, such regulation has been shown to be evolutionarily conserved and important for modulating lifespan in both *C. elegans*, and the fruit fly, *Drosophila melanogaster*."

→ *First sentence of paragraph should indicate what the paragraph's about*

→ *Saying something <u>about</u> the topic is more interesting than only stating it*

Paragraph structure depends on content

The topic sentences of this example state the paragraph's message (that neurosensory regulation is important for modulating lifespan), which works in this case because it helps transition from earlier material on other processes affected by neurosensory regulation. This example might suggest that all topic sentences should convey the message—that would ensure that you communicated it and would require fewer sentences than stating the topic in one sentence and the message in another. However, the message may not be as convincing without first explaining the reasoning that justifies it, so the message must be stated later in the paragraph and the beginning can only indicate the topic. For example, the message of the second paragraph of the discussion example in lesson 5, is a possible reason for slower decay of negative emotions than positive ones. Stating this reason before giving the additional evidence, comments from one of the patients about negative emotions in her everyday life, wouldn't make a lot of sense.

→ *State the paragraph's message either at the beginning or the end*

How to make your paragraph beginnings signal

Writing paragraphs that signal what they're about is much easier when they're composed according to a plan, since the plan specifies each paragraph's purpose. However, even if you prefer not to plan or your draft veers from the plan, you can go back through a draft to improve how accurately the beginning of each one indicates the paragraph's topic. One especially systematic approach is to do something similar to a reverse outline using note cards: write the purpose of each paragraph on one side, and the first sentence or two of each paragraph on the other. This method is especially helpful because it allows you to write the purpose without looking at the first couple of sentences, so you might be more inclined to write what you

intended the paragraph to do or the purpose that makes the most sense for the piece of writing rather than something that matches your topic sentences. After you've completed cards for all the paragraphs, look at the topic sentences and guess at what the purpose of the paragraph is. Having someone else do this part may be more effective if you still remember what the purpose you wrote was and can't come up with anything else. If the guessed purpose doesn't match the one you wrote, the topic sentences need revision.

→ *Note card revision*

- *First one or two sentences on one side, purpose of paragraph on other*
- *Make sure they correspond; if not, revise beginning of paragraph*

Let's use a modified version of the note card approach on this passage:

Example 2: inaccurate topic sentences, **Part 1**: text

Dystonia is a movement disorder characterized by involuntary twisting and contraction of skeletal muscles. Collectively, different types of dystonia are estimated to affect over 3 million people worldwide [1]. Early-onset torsion dystonia (EOTD) is a severe and heritable form of dystonia that is transmitted in an autosomal dominant manner with reduced penetrance (30–40%). This disorder is associated with mutations in the human *DYT1* gene (also known as *TOR1A*) that result in the loss of one of a pair of glutamic acid residues (ΔE302/303) in the C-terminal region of a protein termed torsinA (2). Torsins (a collective term for torsinA and its homologs) are members of the large and functionally diverse AAA+ (ATPases associated with cellular activity) family of ATPase proteins. Several AAA+ proteins function as oligomeric complexes involved in facilitating protein folding and guidance to cellular locations (3). In this regard, torsinA is predicted to affect the conformational state of proteins and their interactions with other proteins (4; 5).

Evidence from multiple labs and systems indicates that the endoplasmic reticulum (ER) is a predominant site of torsin localization (6; 7; 8; 9; 10; 11). Indeed, torsins exhibit chaperone-like activity in vivo and have been shown to prevent the accumulation of both α-synuclein and polyglutamine-repeat-containing fusion proteins when overexpressed (12; 13). More recently, functional analyses of endogenous torsinA activity in human fibroblasts indicate that it is involved in the trafficking of proteins through the ER secretory pathway, with loss/downregulation of torsinA, or mutant torsinA, interfering with this process (14; 15). It was also demonstrated recently that mutations in the ϵ-sarcoglycan gene (*DYT11*, also known as *SGCE*) product (SGCE), which are associated with myoclonus dystonia, result in an ER-based trafficking defect, and that over-expressed mutant SGCE proteins were selectively degraded in the presence of torsinA (16). These combined studies strongly suggest that a normal activity of torsinA involves maintaining the homeostatic balance of proper protein folding and processing in the cell, and that the loss of torsinA function in dystonia potentially renders cells more susceptible to intracellular stressors, such as those associated with the unfolded protein response (UPR) (17; 18; 19).

Mutant torsinA (ΔE) exhibits reduced ATPase activity as compared with WT torsinA, and the mutant form inhibits WT ATPase activity in mixed protein preparations in vitro (20). It has been further demonstrated, in cell culture, that the absence of the glutamic acid (ΔE) residue in torsinA can result in the formation of aberrant membranous inclusions and increased subcellular

distribution of this protein at the nuclear envelope (NE) (**21**; **22**; **23**). Other studies support a role for torsinA in cytoskeletal dynamics interactions through its interaction with nesprins and their associated protein partners in the lumen of the NE, affecting the role of these proteins in nuclear and cell movement (24). Similarly, mutations in an ER-resident, embryonically expressed *C. elegans* torsinA ortholog, OOC-5, cause deficits in nuclear rotation (25). These reports imply that the molecular nature of this disease might be a combined consequence of reduced torsinA activity causing ER and NE dysfunction. Although studies pertaining to mutant torsinA (ΔE) localization are potentially informative with respect to the molecular pathology of EOTD, they are not readily amenable to drug-screening approaches, which depend on quantitative profiling of drug potency or efficacy.

Other movement disorders, such as Parkinson's disease and Huntington's disease, involve the loss of large populations of neurons. In contrast, there is no obvious neurodegeneration in EOTD patient brains (26; 27); further, the mutation in *DYT1* is incompletely penetrant. Therefore, subtle causes of cellular dysfunction are most likely to be responsible for the symptomatic features of dystonia, possibly related to defects in secretion that compromise neurotransmission, or to increased sensitivity to ER stress, which compromises neuronal integrity. Considering this, EOTD represents an outstanding candidate disorder for therapeutic intervention, since even incremental increases in torsinA activity could potentially restore normal movement control to the dysfunctional neuronal circuitry.

Modified from Cao S et al., Chemical enhancement of torsinA function in cell and animal models of torsion dystonia, *Dis Model Mech* May/June 2010 v3(5-6): 386-396.

This passage may not strike you as one in desperate need of revision, but several paragraphs don't really indicate where they're going. Thus, even when the paragraphs are unified and coherent, there may still be room for improvement. First, let's summarize each paragraph's purpose and compare it to the first sentence:

Example 2: inaccurate topic sentences, **Part 2**: compare messages to topic sentences

Paragraph	Topic	First sentences
1	Why torsinA and torsinAΔE are important	Dystonia is a movement disorder; affects many people
2	Function of torsinA	TorsinA localizes to the ER; prevents accumulation of specific overexpressed proteins
3	How the ΔE mutation affects torsinA function	ΔE mutation reduces ATPase activity
4	Why increasing torsinA function may help treat EOTD	Other movement disorders involve neurodegeneration; EOTD doesn't

Deciding on revisions

Clearly, most of the first sentences of the paragraphs don't accurately indicate the scope of the paragraphs' topics. They begin either with general information that stalls getting to the actual topic or with details about the topic whose relevance to the point of the paragraph the reader has to guess at. One way to revise these

paragraphs would be to tack new sentences onto the front of each one, as we did with Example 1. However, this may be more effort than we need to put forth: an appropriate sentence or phrase that indicates the paragraph's topic might already be in the passage. [Try going back to the example to find such sentences.] We can reorganize the sentences so that these appear at the beginning of each paragraph.

Par. 1 In the first paragraph, the sentence that shows why torsinA is important is the one that states that its gene is mutated in EOTD. Making that sentence the first one doesn't quite work, since the reader wouldn't yet know what dystonia is, so it needs to follow the definition sentence. This makes the sentence about prevalence seem out of place—it's no longer relevant since the paragraph's focus is narrowed to EOTD, so we can delete it.

Par. 2 The topic of the second paragraph is suggested by the last sentence of the first, which indicates that the break between the two may not be in the best place. As in the first paragraph, we can't just move the sentence to the second paragraph since it wouldn't be clear to what "in this regard" refers if you were scanning the paper. Replacing the transition with something more explicit would make it work as a topic sentence; we'd also need to add a transition to the next sentence.

Par. 3 The third paragraph opens very specifically, with the ΔE mutation's effect on torsinA's ATPase activity. However, the only general statement about the mutation's effect on the protein as a whole (the second-to-last sentence) also mentions reduced activity. We could modify the first sentence to mention ER and NE dysfunction and delete the summary sentence near the end, but that may not be necessary. The decrease in activity is the most fundamental way to describe the effect of the mutation, and the reader can infer from this and the information on torsinA's function in the previous paragraph that the mutation would lead to ER dysfunction.

Par. 4 Similar to paragraph 1, the message here is buried in the middle—we just need to move it up, while keeping the information necessary to understand it earlier in the paragraph. The rationale here is very similar, so we'll skip the details and get to the revision:

Example 2: inaccurate topic sentences, **Part 3**: revision

Dystonia is a movement disorder characterized by involuntary twisting and contraction of skeletal muscles. Early-onset torsion dystonia (EOTD) is a severe and heritable form of dystonia that is transmitted in an autosomal dominant manner with reduced penetrance (30–40%). This disorder is associated with mutations… Several AAA+ proteins function as oligomeric complexes involved in facilitating protein folding and guidance to cellular locations.

Based on the function of related proteins, torsinA is predicted to affect the conformational state of proteins and their interactions with other proteins (4; 5). Consistent with this function, evidence from multiple labs and systems indicates that the endoplasmic reticulum (ER) is a predominant site of torsin localization (6; 7; 8; 9; 10; 11). Indeed, torsins exhibit …

In contrast to other movement disorders, such as Parkinson's and Huntington's, EOTD does not involve obvious neurodegeneration (26; 27). Therefore, subtle causes of cellular dysfunction are most likely to be responsible for the symptomatic features of dystonia, possibly related to defects in secretion that compromise neurotransmission, or to increased sensitivity to ER stress, which compromises neuronal integrity. Considering this and the mutation's incomplete penetrance, EOTD represents an outstanding candidate disorder for therapeutic intervention, since even incremental increases in torsinA activity could potentially restore normal movement control to the dysfunctional neuronal circuitry.

Order sentences logically

The beginning of the paragraph isn't the only part to worry about when trying to improve the internal organization of a paragraph—we've still got to figure out how to deal with all those other sentences. The order of the sentences in a paragraph may not seem all that important, but arranging them according to some logic allows you to indicate that logic to the reader (using transitions—see lesson 12). Indicating the relationships among the sentences helps the reader understand why you included each one and how it advances the narrative or argument. Sometimes, there's only one order of sentences within a paragraph that makes sense, such as when each sentence uses the information or reasoning in the previous one to reach the next logical step. If multiple sentence orders are possible because several sentences all have the same relationship to the paragraph's purpose, choose one that allows you to indicate how the sentences are related to one another. For example:

Example 3 version 1: disordered sentences

Many species engage in cooperation through "kin selection" in which they help relatives and, in effect, themselves through promoting their shared genes. Chimpanzees potentially demonstrate empathy in cases where they selflessly help others, even members of a different species, if they recognize that an individual needs assistance. Vampire bats will engage in "reciprocal altruism" with unrelated members of their group by sharing blood with their hungry neighbors in the anticipation that they will be shared with as well on nights when they go hungry. Rats will engage in "generalized reciprocity" and share with a complete stranger if another stranger had previously shared with them.
[from the Primate Diaries blog post "Helpful Cichlids in the Gladiator's Show"]

In this paragraph, the last three sentences are all evidence that support the claim in the topic sentence. Arranging them according to an internal order allows the author to include transitions:

Example 3 version 2: logical order

Many species engage in cooperation through "kin selection" in which they help relatives and, in effect, themselves through promoting their shared genes. Vampire bats will engage in "reciprocal altruism" with unrelated members of their group by sharing blood with their hungry neighbors in the anticipation that they will be shared with as well on nights when they go hungry. In more dramatic cases, rats will engage in "generalized reciprocity" and share with a complete stranger if another stranger had previously shared with them. Perhaps most remarkably, chimpanzees potentially demonstrate empathy in cases where they selflessly help others, even members of a different species, if they recognize that an individual needs assistance.

The supporting sentences are now in order of increasing distance between the altruistic individual and the animal that individual helps. This helps the reader infer that the author may have chosen these examples to show the wide range of altruistic behavior.