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How to draft the introduction for a science research paper.

https://youtu.be/9l9LDX-Ycqk

It's probably safe to say that pretty much all students approach the first research paper like they approach an essay assignment. They want to demonstrate what they have learned to a more experienced and knowledgeable expert - the professor - whose job it is to evaluate them.

But this is not what a research paper is about. Your audience isn't more knowledgeable than you are - or let's say: they shouldn' be - on the particular study.

This is why you need to motivate the reader to follow your thoughts, find your question compelling, and your approach valid.

Structure

The introduction leads the reader down a "funnel" from the broad, big picture topic to the narrow question, the study, and the conclusion.

The introduction is not a full review of the background. Rather you want to keep it clear and concise. Tell the readers what they need to know to follow your approach, and nothing more.

A good strategy to outline the introduction is to begin at the end and then systematically ask yourself the question "How did you get here?". You answer the question with a single sentence. This way you end up with a straight story.

In my video I use the following paper as an example:

Eckmeier, D, Shea, SD (2014). Noradrenergic Plasticity of Olfactory Sensory Neuron Inputs to the Main Olfactory Bulb.

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Introduction

Sensory responses, cognition, and behavior are modulated by noradrenaline (for review, see Usher et al., 1999; Aston-Jones and Cohen, 2005; Bouret and Sara, 2005; Valentino and Van Bockstaele, 2008; Berridge et al., 2012; Devore and Linster, 2012), which is released throughout the forebrain by the brainstem nucleus locus ceruleus (LC). In the main olfactory bulb (MOB), noradrenaline is involved in odor learning and discrimination of many stimuli, including social cues (Pissonnier et al., 1985; Sullivan et al., 1989, 1992, 2000; Kendrick et al., 1991; Rangel and Leon, 1995; Brennan et al., 1998; Guérin et al., 2008; Mandairon et al., 2008). Yet, it remains unclear which cell types are persistently modulated by noradrenaline.

Olfactory sensory neurons (OSNs) and mitral/tufted cells (MTs) form the first synapse of the main olfactory system. Axonal terminals of OSNs expressing the same receptor proteins converge onto MTs, forming glomeruli at the MOB surface (Chen and Shepherd, 2005). This organization defines a spatial representation of odors (Mombaerts, 2006) that is readily imaged (Rubin and Katz, 1999; Uchida et al., 2000; Meister and Bonhoeffer, 2001; Wachowiak and Cohen, 2001; Bozza et al., 2004; Lin da et al., 2006; Fletcher et al., 2009; Ma et al., 2012). In deeper layers MTs receive inhibitory feedback from granule cells (Jahr and Nicoll, 1980; Isaacson and Strowbridge, 1998).

Noradrenaline can acutely inhibit granule cells (Nai et al., 2009, 2010; Linster et al., 2011), and thereby transiently disinhibits MTs, which may contribute to plastic changes in the MOB (Pandipati et al., 2010). Indeed, responses of MTs to odors presented during noradrenaline release are incrementally and persistently suppressed (Wilson et al., 1987; Sullivan et al., 1989; Shea et al., 2008). This is correlated with an increase in GABA relative to glutamate (Kendrick et al., 1992; Brennan et al., 1998) suggesting that the suppression involves inhibition.

The glomerular layer also receives noradrenergic input and expresses adrenergic receptors (Day et al., 1997; Winzer-Serhan et al., 1997a,b), thus interneurons in the glomerular layer may also regulate OSN output. While acute activation of noradrenaline receptors did not modulate OSN output in one study (Hayar et al., 2001), persistent effects were not assessed.

We investigated whether LC activation persistently modulates OSN activity in anesthetized mice. We measured the activation of glomeruli with wide-field imaging of intrinsic optical and fluorescent calcium signals. Surprisingly, we observed a persistent noradrenaline-dependent reduction in the odor response of OSNs. The suppression affected the responses to odors presented during or between LC activation trials equally. However, the suppression was intensified when no odors were presented during the LC stimulation phase. Arousal-dependent olfactory memories may therefore alter odor-evoked synaptic activity as peripheral as the first synapse in the main olfactory system.

1. Write down the main **CONCLUSION**.
   It is very important that it doesn't differ (in content) from the conclusion in your discussion:

   "Arousal-dependent olfactory memories may alter odor-evoked synaptic activity as peripheral as the first synapse in the main olfactory system."

2. How did you get to your conclusion? **MAIN RESULT**!

   "we observed a persistent noradrenaline-dependent reduction in the odor response of OSNs. The suppression affected the responses to odors presented during or between LC activation trials equally"

3. How did you get your results? **EXPERIMENTAL APPROACH!**

   "We measured the activation of glomeruli with wide-field imaging of intrinsic optical and fluorescent calcium signals. "

4. Why did you choose this approach? Because it is suited to answer your **SPECIFIC RESEARCH QUESTION**

   "We investigated whether LC activation persistently modulates OSN activity in anesthetized mice."

5. How did you come up with the question? It is meant to close a **KNOWLEDGE GAP** that you identified in the literature.

   "The glomerular layer receives noradrenergic input and expresses adrenergic receptors, thus interneurons in the glomerular layer may also regulate OSN output [... , but] persistent effects were not assessed."

6. How did you find the knowledge gap? By researching the **CONTEXT** in the related literature.

   "Noradrenaline can acutely inhibit granule cells, and thereby transiently disinhibits Mitral/Tufted cells, which may contribute to plastic changes in the Main Olfactory Bulb."

7. Why do you suspect this should be the case? It's implied by previous research, the **BACKGROUND**.

   "Olfactory sensory neurons (OSNs) and mitral/tufted cells (MTs) form the first synapse of the main olfactory system. " et cetera

8. Why are you working on this topic? It's the subject of my **SUBFIELD**.

   "In the main olfactory bulb (MOB), noradrenaline is involved in odor learning and discrimination of many stimuli, including social cues"

9. In which bigger topic(s) does your research fit? Here are the **BIG PICTURE** topics my work touches on:

   "Sensory responses, cognition, and behavior are modulated by noradrenaline"

Note, that we already introduced an important research question in the first paragraph:
" it remains unclear which cell types are persistently modulated by noradrenaline."

This sentence is quite important, because it motivates the whole study, and raises the interest of the reader in learning more.