The Basics:
1. What was the broad question being asked by this research project? What was the specific question being asked by this research project?
    a. Summarize the background information on the research topic in three sentences.
    b. What is the gap in the literature identified by the researchers? What question(s) are they trying to answer? What is their hypothesis and what should happen if the author's hypothesis is true?
    c. What are alternative hypotheses?

General: *How do humans share attention in social settings? How do individuals get in "tune" with each other during moments of shared attention?* Specific: *Do individuals' pupils dilate in tune with hypothetical (here: videotaped) conversational partners?*

Background: there's evidence for shared mental states (mirroring people during conversation, emotions, heart rates, etc.). Pupil dilation might synchronize because of physiological systems related to arousal and salience (norepinephrine, locus coeruleus).

Hypothesis: If pupil dilation 'reflects the ebb and flow of attention,' pupils will be synchronized when people share attention (positively and negatively valenced conversations).

Alternate hypothesis: They don't specify one – it could've been possible that pupils synchronize during positive but not negative conversation, or they don't synchronize at all. It's usually not good when a paper doesn't specify multiple hypotheses for what would happen because the paper then just becomes about showing an effect exists without giving context to the literature

2. What experiments were done to test the hypothesis or investigate the research question?
    a. Explain the task design – what are participants instructed to do and what is being measured? Think about the independent and dependent variables.

Fig 1: White women ranked low and high in expressiveness on a questionnaire were videotaped when telling emotional autobiographical stories (~2.85 min in length; Speakers). Speakers rated the overall valence and arousal of their own memories, wrote them down for the researchers, and were primed to feel the emotional state of their memory before telling the story. Listeners, who varied in their ability to assume other's viewpoints (via a questionnaire), watched the videos while being eyetracked. They rated how likable or engaging the speakers were. Raters independently made ratings of how emotionally salient the individual videos were so that the researchers knew across time how salient the story was. Researchers performed preprocessing analyses so that their eye-tracking data was less noisy, and they had a continuous measure of how pupil dilation changed over the course of each story, for each participant.

3. What evidence supports each of the conclusions?
    a. Before you read the discussion, summarize the main findings and link each one back to the research question(s). How does each result inform the hypothesis?

Higher scores on cognitive empathy for Listeners meant more synchrony of pupil dilation with speakers who were more expressive (Figures 2 and 3). The relationship didn't exist for speakers who were less expressive.

- They replicated this effect in an audio-only adaptation of the videos (so it's not an artifact of physical features).

More empathic Listeners tended to like Speakers more overall. Shared attention alone (via pupil synchrony) didn't explain as much variance in the liking ratings of Speakers.

For 7/8 of the stories, listeners synchronized their pupil dilations during the engaging or emotionally portions of the narrative (Figures 4 and 5) as measured by how collective (group-level) synchrony related to the independent raters' coding of the salience in the story.

4. What are the major conclusions?
   a. What do the results add to the field? How do the researchers interpret their findings? Summarize any limitations identified by the researchers.

Minds (inferred indirectly via pupil dilation) are coupled when stories are engaging, and this is mostly qualified by the expressiveness of the speaker and the ability of the listener to infer what the speaker is feeling.

Pupil dilation is a very indirect measure (as the authors state 'aggregate influence of many inputs across multiple timescales, from low-level sensory signals to high level cognitive interpretations'). It might've been nice to have another measure of synchrony.

The Critique:
1. Is the paper well written? How do you know? For week 2 & later, use this space to practice headlines & summaries of the articles via tweets.

The paper was well-written; it didn't go on for ages before telling you what the study was about, and I liked that even the results section was broken into different sections.

2. Do the conclusions seem logical given the data processed? Why or why not? Another way of thinking about this: do the results adequately support the conclusions that are drawn? Are there alternative explanations for the findings? What inferences about the hypotheses and questions can be made based on these results?

I think the conclusions that are made are logical, but there are still some components that are left unanswered, as shown by the number of questions the authors highlight in the discussion (what about passive listening? Why only positive/negative stories? Is it just that people who are good storytellers can capture people's attention more, but not that people are really synchronized? Or that people who are good at inferring other people's states are more likely to pay more attention to stories? The time series suggests synchrony, and they did find that people who are more empathetic liked the Speakers more -maybe both? Since the hypothesis was just that the effect exists, there's not much other inference.

3. Are the conclusions important? How do you think this relates to everyday behavior?

I think the conclusions are interesting. I think it's good to think about long-held beliefs that people have about the world (eyes reveal the mind) and test whether they actually apply or are

folk behaviors. Whether you can *apply* this research is a bit more difficult—unless it's something like consumer neuroscience (see below).

4. What were the best aspects of the research presented, and how could the research be improved? Name at least one way to improve the experiment.

It's a little unclear to me why expressiveness and cognitive empathy had these relationships. Is the idea then that this is not a general principle of cognition but that only people who try to relate to other people collectively synchronize their attention? I also think that it would've been nice to have a full continuum of expressiveness for Speakers and cognitive empathy for Listeners to make sure that this effect isn't an effect of "the outliers" in the world (if so: is it still interesting?). I think the best aspects are the immediate real-world relevance + the sophisticated way of transforming the data into time courses – but then making the story feel simple.

5. How would you follow-up this experiment or study?

I'd love to test the premise of this study in one of those collective story-telling rooms or a classroom. I think consumer neuroscience would be interested in these effects – e.g., does collective synchrony predict how much people tend to like the story? Or how many of the details they remember? Do they remember more details about the person if they're more "synced" or do they remember more details about the story itself (i.e., the high points)? The former seems qualified by expressiveness and empathy, per this study (Speaker liking ratings). But, does expressiveness also qualify memory? The decisions you make?

Additional Resources: What are the basic concepts that you need to know to understand the science presented in your paper? What other information or resources would help you better understand the paper? This is helpful to consider for your science communication pieces. *Perhaps a bit more on attention/arousal relationship – the u-shaped curve. Don't want to get into the details on pupil dilation and arousal, since it's indirect.*

Further Questions:
Write at least five comments or questions about the article to discuss with the class.
1. What other individual differences could predict liking ratings? Or is it the topics discussed in the stories?
2. Could this have worked with another methodology? CC: Hasson lab papers on watching Sherlock in the scanner and more (1, 2, 3, 4), plus Suzanne Dikker study below
3. The authors don't comment on this, but they chose white females as their storytellers. How do you think that might have affected results and/or why the authors made that choice?
4. This study isn't what would technically be considered cognitive psychology on its own; why do you think that might be?
5. Suzanne Dikker (Current Biology, 2017) found a similar effect when high school students wore mobile EEG caps; the more their electrical activity was synchronized, the more engaged they were in class, the more they liked their teacher, the more aligned their class dynamics. Is there a way to test these effects in the classroom without caps, without the eye-tracking being obvious? Are there physiological measures that demonstrate student engagement? Heart rate?