Explaining the helium balloon in the car

Discussion Topic: Why does a helium balloon move to the front of the car as it accelerates?

Explanation #1: When the car accelerates, air in the car has a moment of inertia so it stays still, or "moves back" relative to the position of the car. Air in the helium balloon is less dense than air in the balloon, so the balloon is pushed forward by the more dense air outside of the balloon.

Explanation #2: As the car accelerates, the air within the car which is not attached to the car "sloshes" towards the back of the car as it stays in place. The negative pressure gradient created at the front of the car results in the lower density balloon to bob forward.

Explanation #3:

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Reasoning/Evidence for Explanation #1

- Good, scientific language
- Mentions force of why the air moves forward
- Moment of inertia - if an object is at rest it tends to stay at rest
    - Inertia depends on the mass of the object and its speed
- Buoyancy: greater pressure from the bottom than from the top
    - force of the fluid (pressure) on an object

Reasoning/Evidence against Explanation #1

- Is the balloon being pushed or pulled?

Questions: Does the helium balloon also have inertia? Less inertia because less dense? Did the balloon “compress” when it moved forward? Would something dangling from the rearview mirror (like an air freshener) react similarly to the helium balloon? What if the balloon wasn’t on a string?

Explanation #2: As the car accelerates, the air within the car which is not attached to the car "sloshes" towards the back of the car as it stays in place. The negative pressure gradient created at the front of the car results in the lower density balloon to bob forward.

Reasoning/Evidence for Explanation #2

- Diffusion - movement from areas of high concentration to low concentration supports movement within a pressure gradient.
- Good for people with less science background--not as technical
- Every force has an opposite and equal reaction

Reasoning/Evidence against Explanation #2

- Is the balloon being pushed or pulled?
- How does the car moving cause a negative pressure gradient?
- If the air is moving backwards, how does it push something forward?

Explanation #3: The balloon is surrounded by air that is a higher density. As the car moves forward, the air within the car, which is not attached to the car, "sloshes" towards the back of the car. This creates a negative pressure gradient at the front of the car. The pressure on the back of the balloon is greater than the front causing the balloon to move forward.

Reasoning/Evidence for Explanation #3

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Reasoning/Evidence against Explanation #3

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