User Study Instruction

You will see two images on the screen. The first image is the raw (unaltered) image, while the second is an augmented reality (AR) image with virtual content added to the scene. Your task is to compare these images and evaluate the quality of the virtual objects based on 8 aspects. Rate each aspect on a scale of 1 to 5 by clicking the buttons on the screen, where 1 indicates very poor quality and 5 indicates excellent quality.

Raw Image

AR Image

visual coherence	1	2	3	4	5
relative size	1	2	3	4	5
floating	1	2	3	4	5
overlapping/penetrating	1	2	3	4	5
occlusion	1	2	3	4	5
shadow	1	2	3	4	5
light direction	1	2	3	4	5
brightness	1	2	3	4	5

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Aspect 1. Visual Coherence

Please assess how well the virtual content blends seamlessly into the real-world scene.

Quality score: 1

Stand out obviously.

Quality score: 5

Blend seamlessly with the real-world scene.

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Aspect 1. Visual Coherence

You may encounter some special cases:

- Obviously virtual but appropriate.

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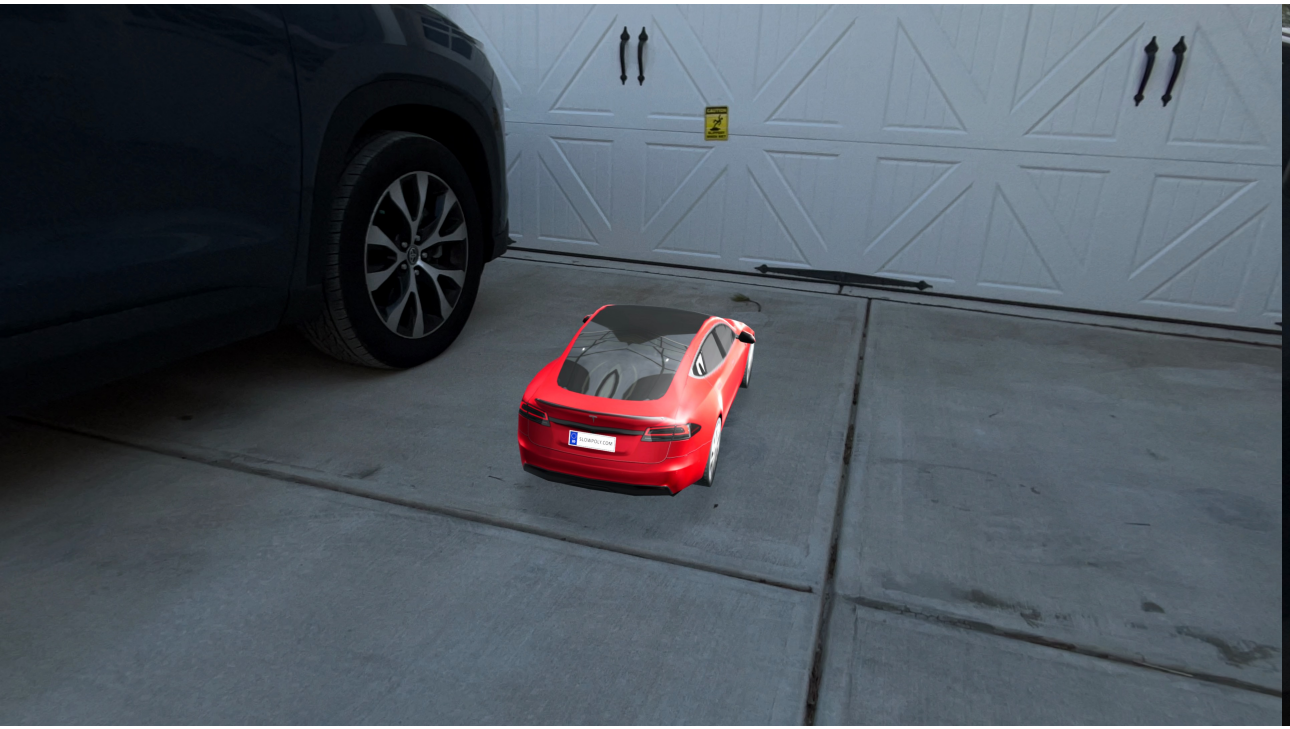
Aspect 2. Relative Size

Please assess whether the virtual object's size appears appropriate for its surroundings. For example, a basketball should be smaller than a person's torso, while a chair shouldn't be as large as an entire room unless the scene specifically calls for exaggerated proportions.



Quality score: 1

Too small

Quality score: 5

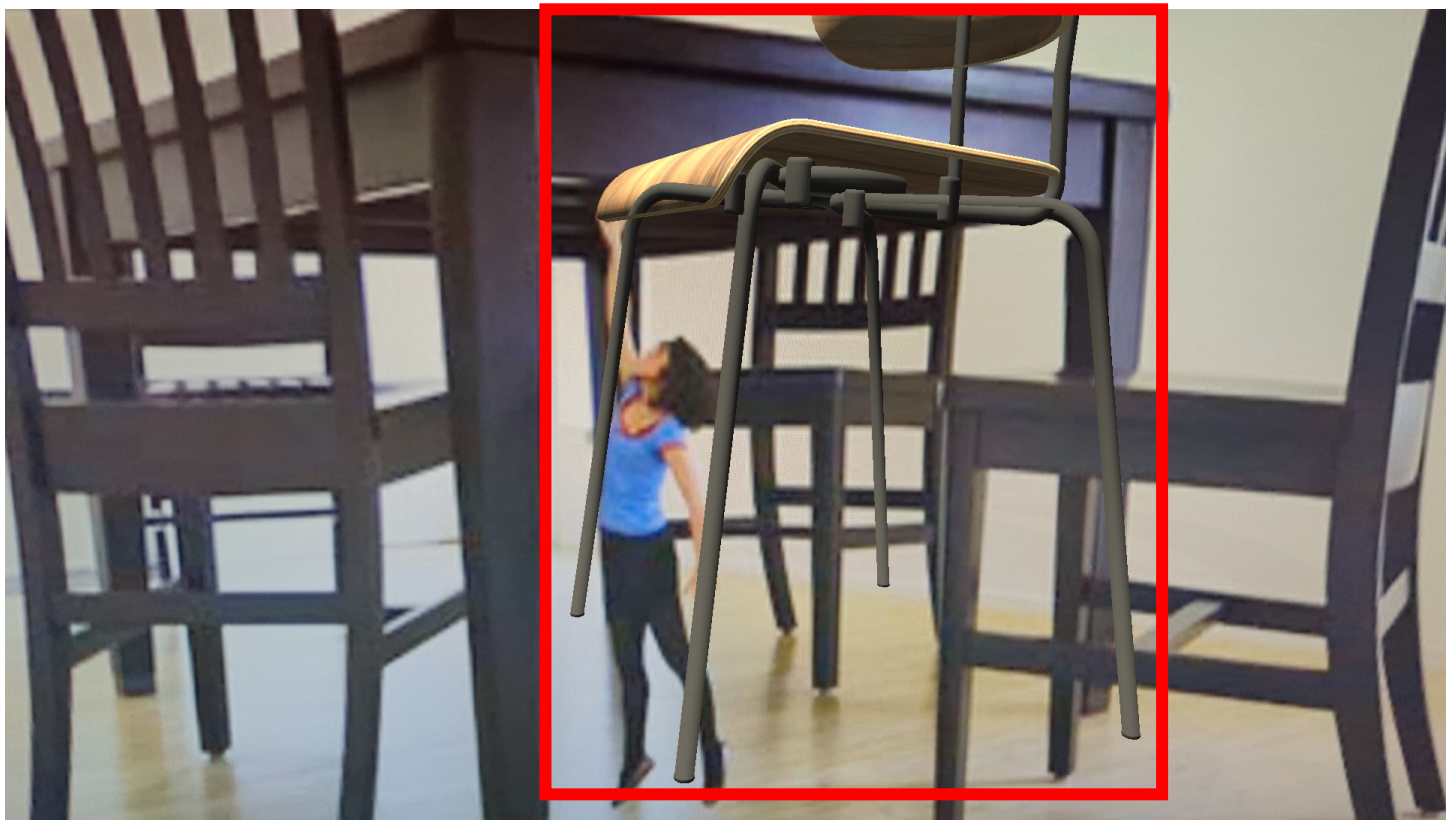
Typical size

User Study Instruction

Aspect 2. Relative Size

You may encounter some special cases:

- Virtual furniture can be giant but still appropriate, since the real furniture is also designed to be oversized.



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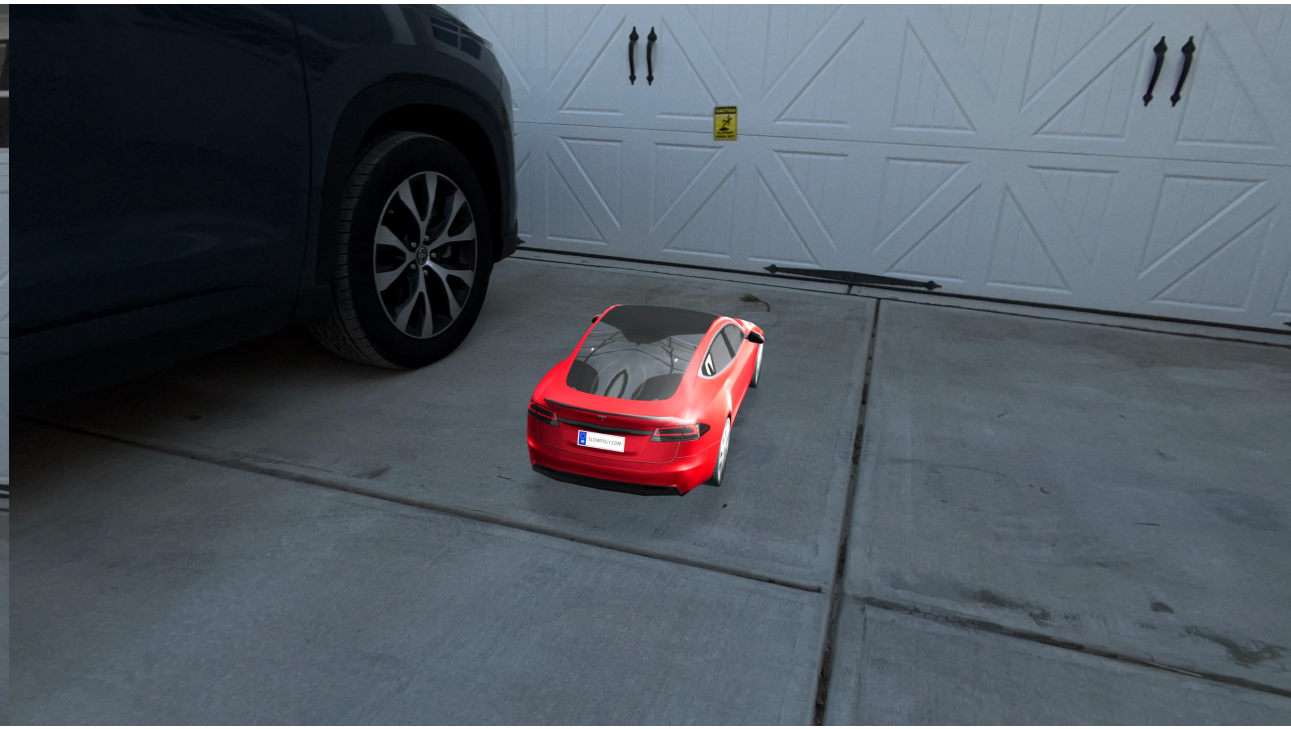
Aspect 3. Object Placement - Floating

Please assess whether the virtual object appears to be floating in a way that doesn't match its surroundings. For example, a basketball can be in the air if it's being thrown, a balloon can float because that's expected, but a chair usually shouldn't float unless the scene clearly shows furniture designed to float.

Quality score: 1

Obviously floating in mid-air.



Quality score: 5

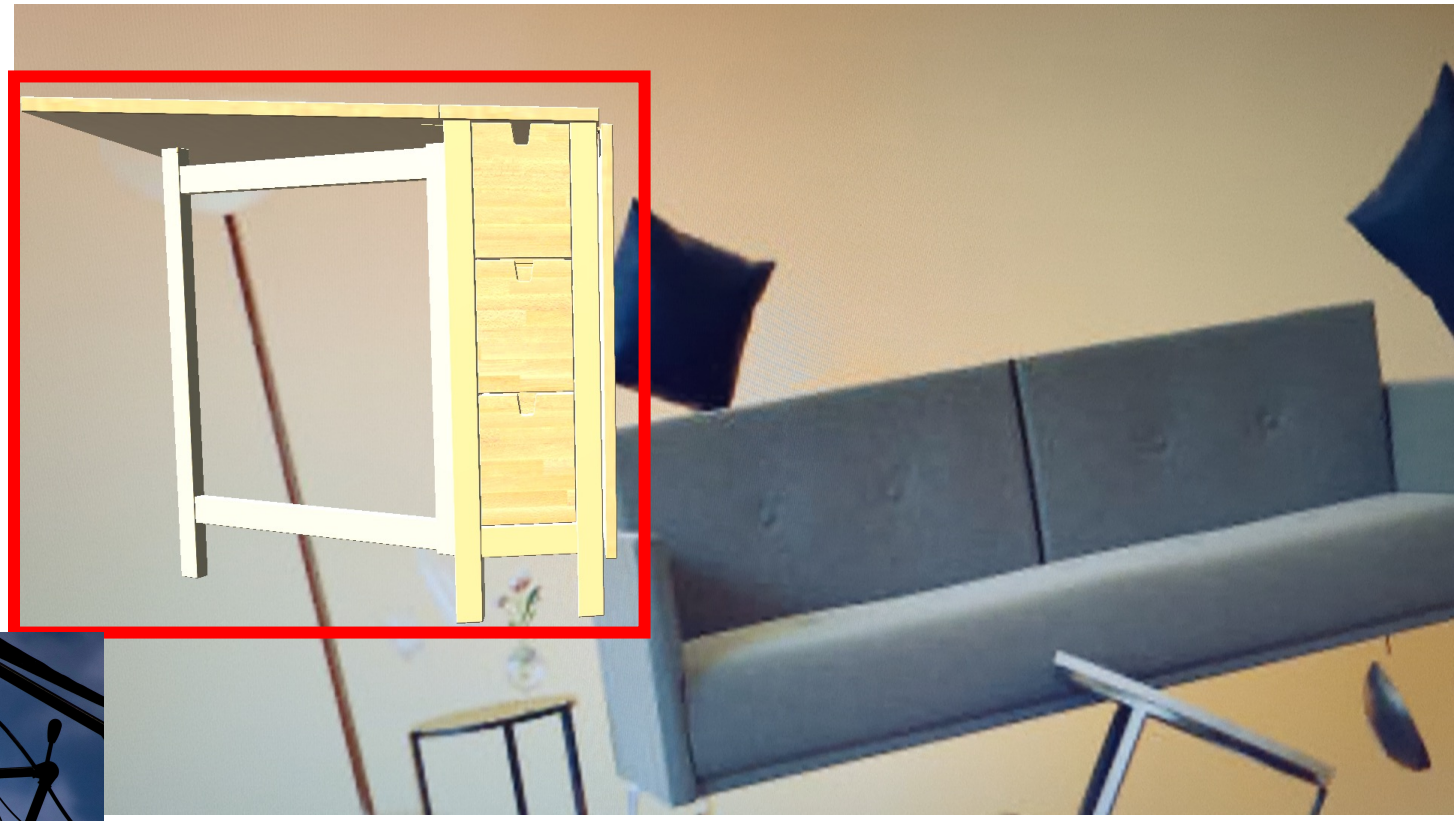
Not floating at all.

User Study Instruction

Aspect 3. Object Placement - Floating

You may encounter some special cases:

- ❖ Floating but appropriate.



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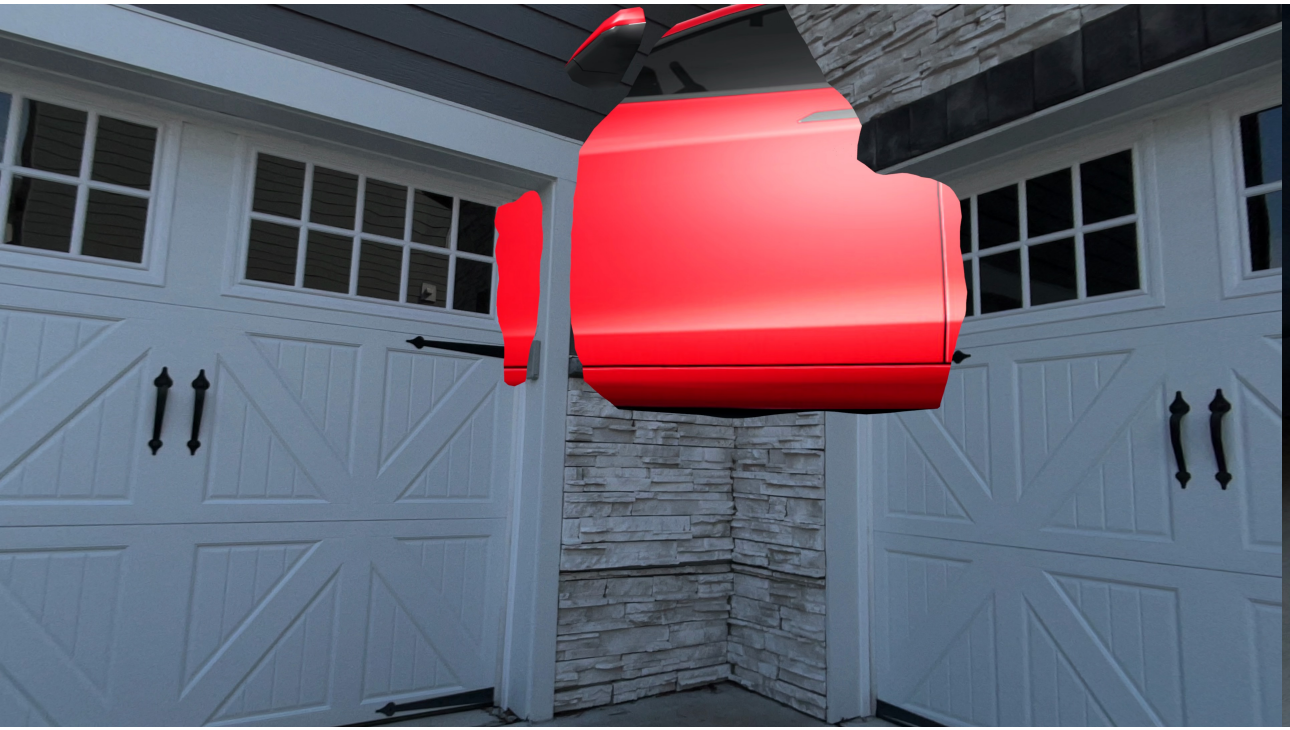
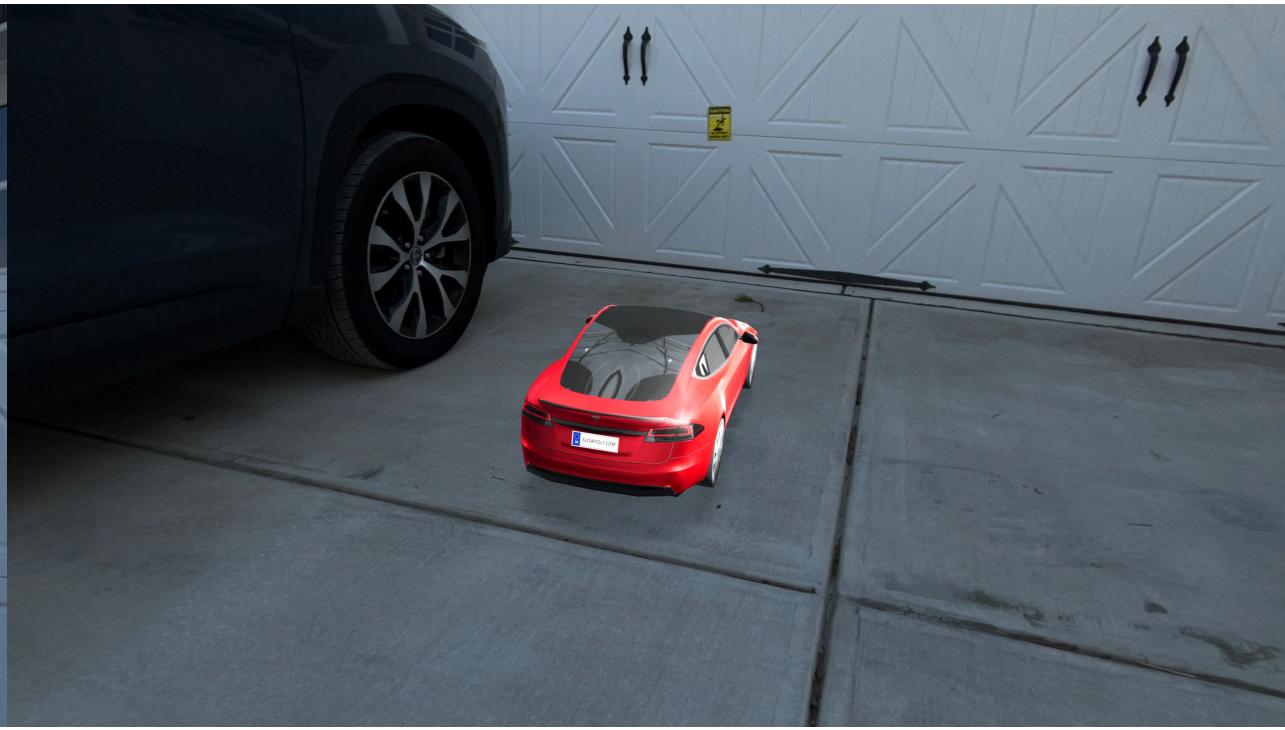
Aspect 4. Object Placement – Overlapping/Penetrating

Please assess whether the virtual object appears to sink into vertical or horizontal surfaces, or if it's being penetrated by real objects. For example, a table leg shouldn't be half-buried in the floor or intersecting a wall.



Quality score: 1

Obviously sinking into the wall.



Quality score: 5

No sinking, overlapping,
or penetrating.

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Aspect 5. Object Placement - Occlusion

Please assess whether the virtual object is blocking critical real-world items like caution signs, electrical devices, or safety equipment. For example, if a caution sign is hidden behind the object, it might create a safety concern.

Quality score: 2~4

Partially obstructing the scissors, which is dangerous, but they remain visible.

Quality score: 5

Not obstructing the knife, a potentially dangerous real-world object.

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Aspect 6. Shadow

Please assess whether the virtual objects' shadows look consistent with the real-world lighting in the scene. For example, if sunlight is coming from the left, their shadows should extend to the right and match the length and intensity of nearby real shadows. However, some demonstration models (like virtual medical organs) may not require shadows, depending on the purpose or style of the presentation.

Quality score: 1

No shadow.

Quality score: 4~5

Realistic shadow geometry, direction, and strength.

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Aspect 6. Shadow

You may encounter some special cases:

- There is no shadow, but this is acceptable because the virtual brain is meant to be inside the human body, where shadow is irrelevant.

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Aspect 7. Light Source Direction

Please assess whether the virtual object's lighting direction matches the real environment's lighting. For example, if the room's main light source comes from the left, the virtual object should also appear lit from the left. However, in certain demonstration or artistic scenarios, it may not be necessary for the virtual object to match the real lighting.

Quality score: 1

Opposite direction.

Quality score: 5

Aligned direction.

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Aspect 7. Light Source Direction

You may encounter some special cases:

- The light direction may appear mismatched, but this is acceptable because the virtual brain is meant to be inside the human body, where external lighting is irrelevant.

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Aspect 8. Light Intensity

Please assess whether the virtual object's brightness is consistent with the real-world environment. For example, if the scene is dimly lit, the object should also appear relatively dim unless it's intentionally highlighted or stylized.

Quality score: 1

Obvious mismatch.

Quality score: 4~5

Consistent light intensity.