Leveraging Virtual Spaces for Human Centered Design

(cultural services: aesthetics & sense of place)

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OVERARCHING QUESTION: Can we use new technologies like virtual reality to improve our ability to design for hard to quantify cultural services such as aesthetics and sense of place *(people's attachment to and identification with natural elements that capture the unique character/identity of a place)?*

Reason for this focus

- We presently don't design for cultural services well
- Cultural services are often relational (they are products of the non-substitutable relationships people have with nature or specific natural features)
- Community engagement in the design process is required. The tools we use must be capable of assessing sensory and emotional connections to infrastructure that does not yet exist
- New technologies are potential game changers because they make the intangible, tangible. They have the potential to create new avenues for public participation that could be used to design for cultural services. **That possibility is the principal focus of the work I'm presenting here.**

Study Design

FIRST STEP: In order to determine whether VR might be a useful way to design for cultural services with communities, we need to determine if the services elicited using VR are realistic

1) Cultural services provisioning by two **real world rain gardens**

2) Built **virtual versions** of the same two systems and evaluated the services they provide

3) Bring the two together to address the utility of VR approaches for evaluating cultural services provisioning (how comparable are virtual and real world perceptions?)

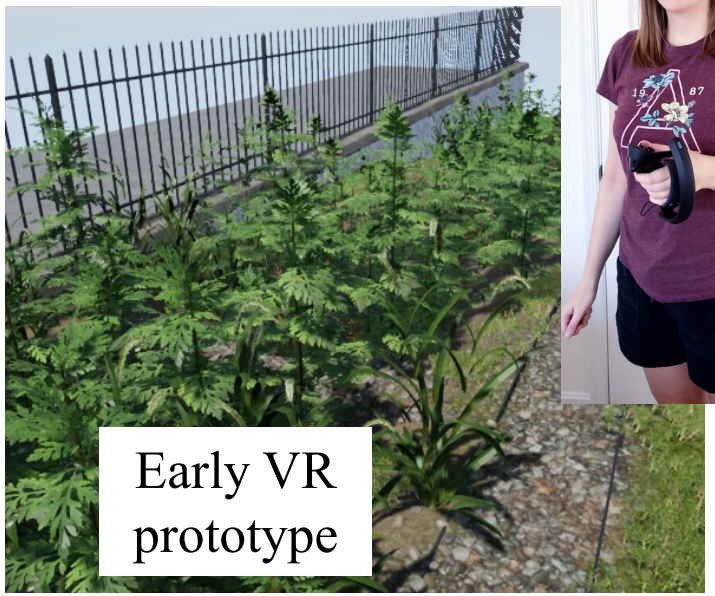
Study Sites

Two rain gardens located on the University of Maryland campus *(both raingardens are well visited and have good pedestrian access: important for onsite surveys)*

Each Study Site Was Reproduced using Virtual Reality

Multiscopic images of common plant species assembled from photographs in Blender

System topography is simulated via 3D photogrammetry using a RTK drone. Plants are added to base topography in Unreal Engine. Plant placement is guided by onsite-plant surveys



Virtual sites can be visualized in simulated walkthroughs using a Vive headset and handheld controllers

Each Study Site Was Reproduced using Virtual Reality

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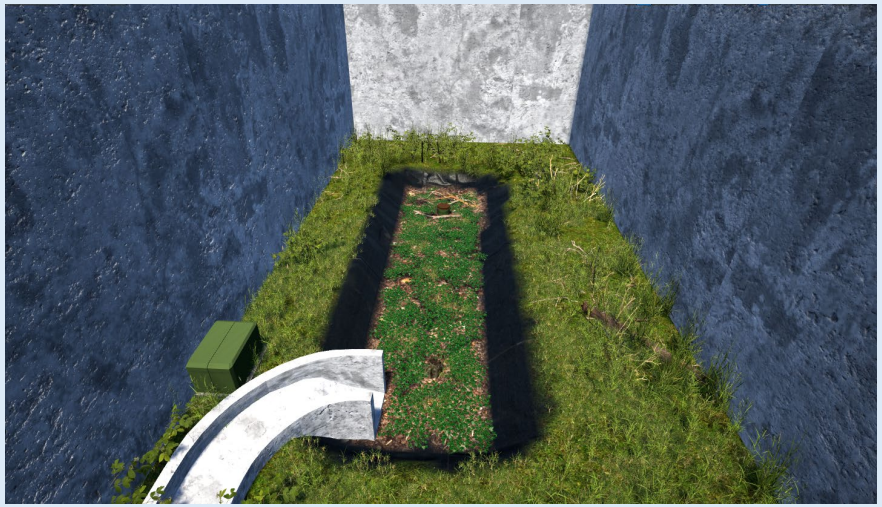
Two virtual models for each system



Rain-garden only
(bounded w white walls)

?

Expected to increase perceptual realism

Situated in context (shown with broader landscape surrounds)

Participants were recruited to view onsite or virtual reality rain gardens and then complete a cultural services survey

Each participant was asked to respond to 5 aesthetics and sense of place questions about onsite or VR rain gardens

They were also asked to view four landscape photos (pavement, turf grass lawn, mixed grass/trees and shrubs/trees) and respond to the same series of questions

- This was done so that we can benchmark perceptions about rain gardens with other common landscapes, contextualizing them

Survey Questions

Please consider the landscape (or photo) in front of you and then respond to the following statement using the scale bar provided (range: 0% agree to 100% agree)

Aesthetics

- I find this landscape attractive
- I find the plants that are planted in this landscape attractive

Sense of Place

- I enjoy seeing this landscape
  (Place attachment: affective bond or link to a place)
- I feel connected to this landscape
  (Place identity: self-identification with a place)
- I feel that landscapes like this are beneficial to me
  (Place dependence: the utility of a place to an individual)

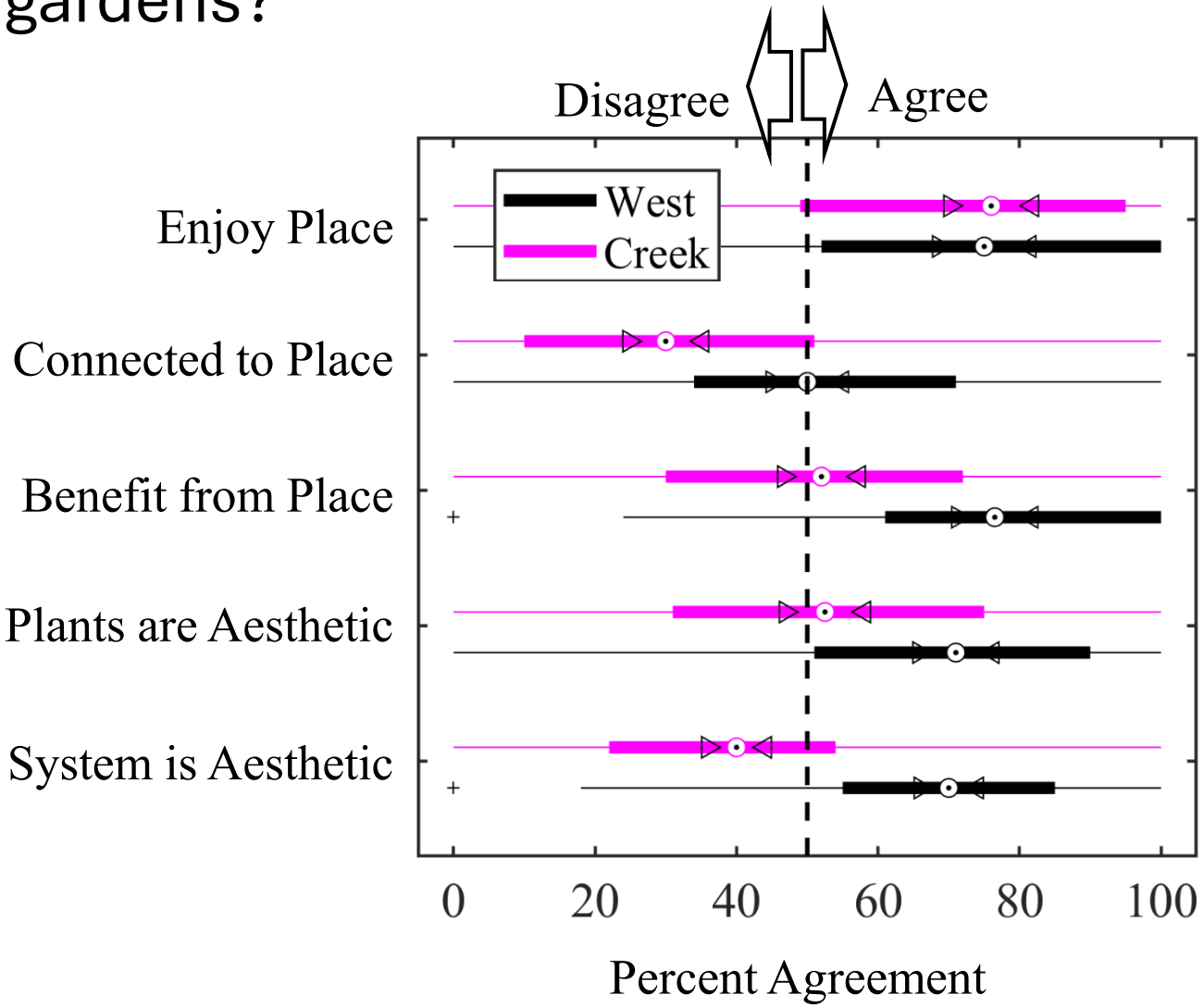
Results: What did we find?

1) What level of cultural services provisioning is perceived for real rain gardens?

2) How do virtual systems compare?

3) Does modeling situational context improve realism?

What level of cultural services provisioning is perceived for real rain gardens?



Perceptions of cultural services provisioning are quite variable

(the entire response range was used for all services)

What level of cultural services provisioning is perceived for real rain gardens?

SENSE OF PLACE

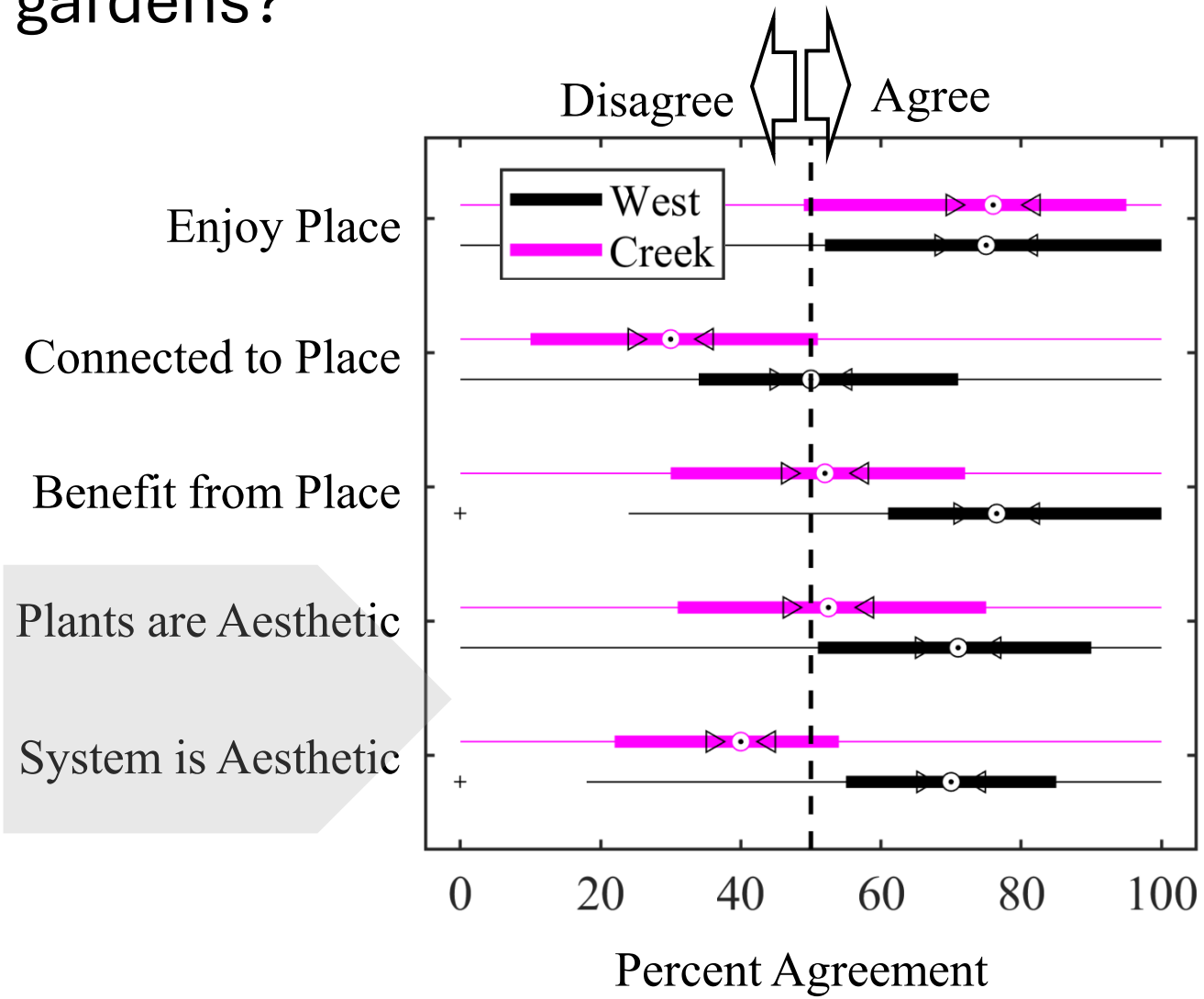
Both rain gardens contributed to enjoyment of place (**place attachment**)

Neither contributed to self-identification with place (**place identity**)

Only one rain garden (UMD West) was perceived to generate benefits (contributing to **place dependence**)

Place attachment and place dependence appear to be the most important domains of sense of place that are influenced by green infrastructure

What level of cultural services provisioning is perceived for real rain gardens?



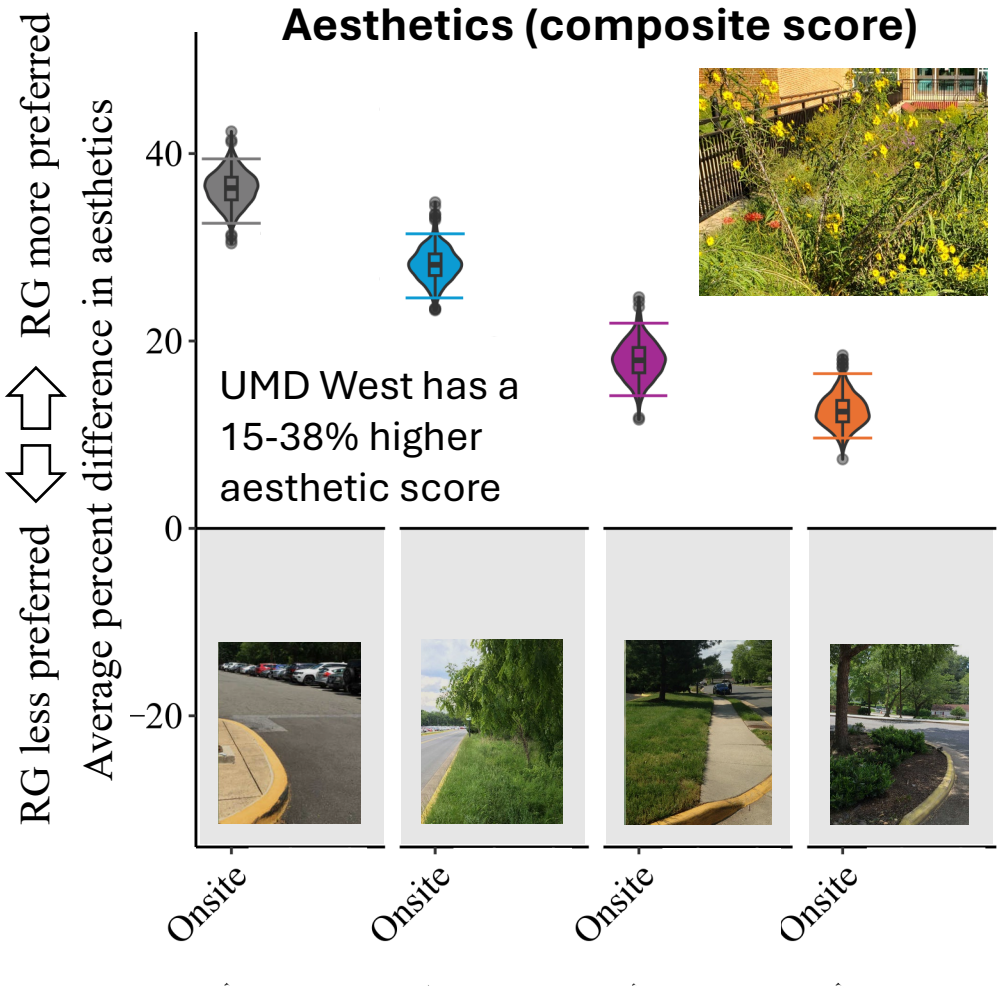
AESTHETICS

Only UMD West was considered aesthetic (true for vegetative design and the entire rain garden system, which includes its engineering design elements)

UMD creek was viewed as less aesthetic, particularly in respect to its engineering design elements

We often think of aesthetics as a principal cultural service rain gardens provide, but its really quite variable (place attachment is much more stable)

What do these scores mean?: Are rain gardens perceived to provide more or fewer services than other urban landscapes?

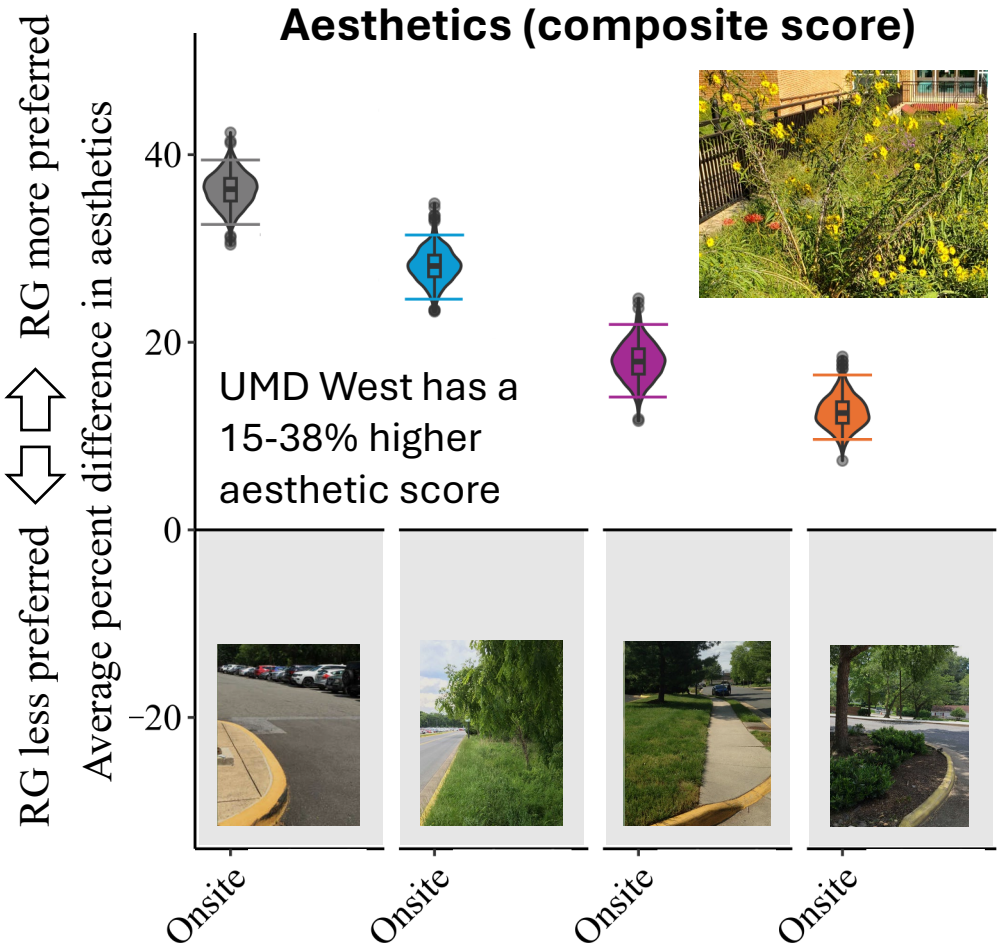


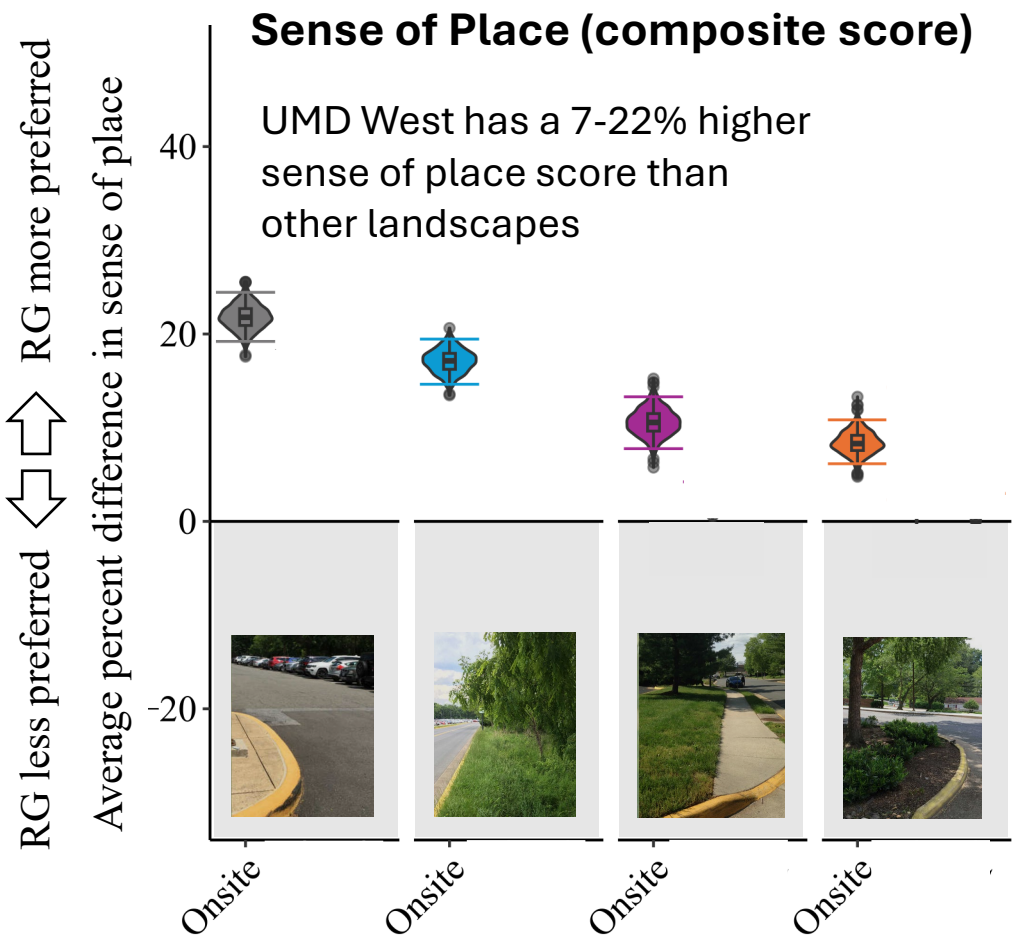
BENCHMARKS: Look at the difference in aesthetic scores between rain gardens and other landscapes (photo insert) to get a sense of their relative value

- Positive values (rain garden preferred)
- Negative values (other landscape preferred)

Horizontal lines represent 95% confidence bounds *(anytime they exclude zero we can conclude that the services provided by rain gardens is significantly different than other landscapes)*

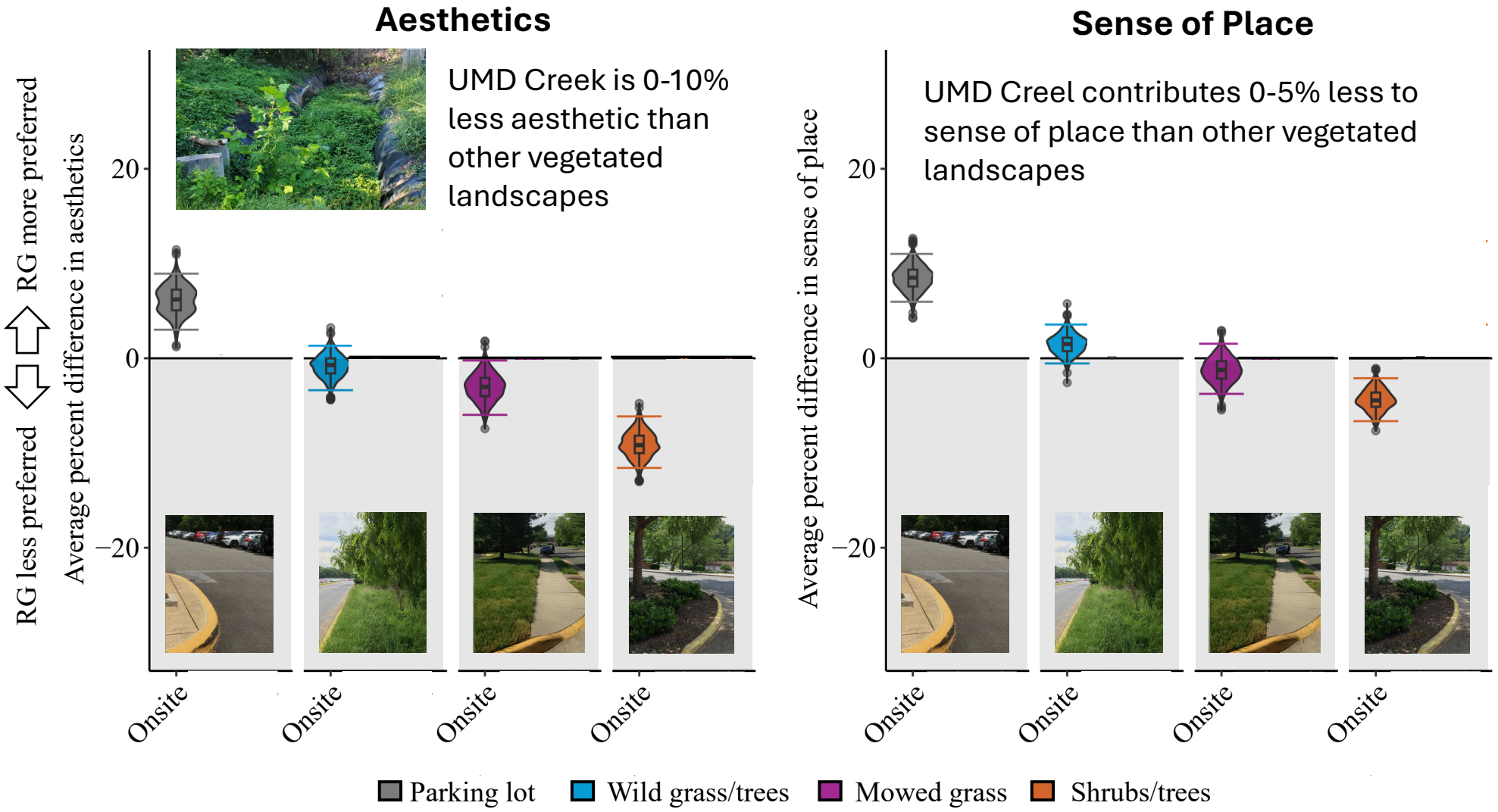
What do these scores mean?: Are rain gardens perceived to provide more or fewer services than other urban landscapes?





Parking lot Wild grass/trees Mowed grass Shrubs/trees

Not all rain gardens are created equal! (UMD creek only has higher aesthetic and sense of place scores than parking lots – 5-10% higher)

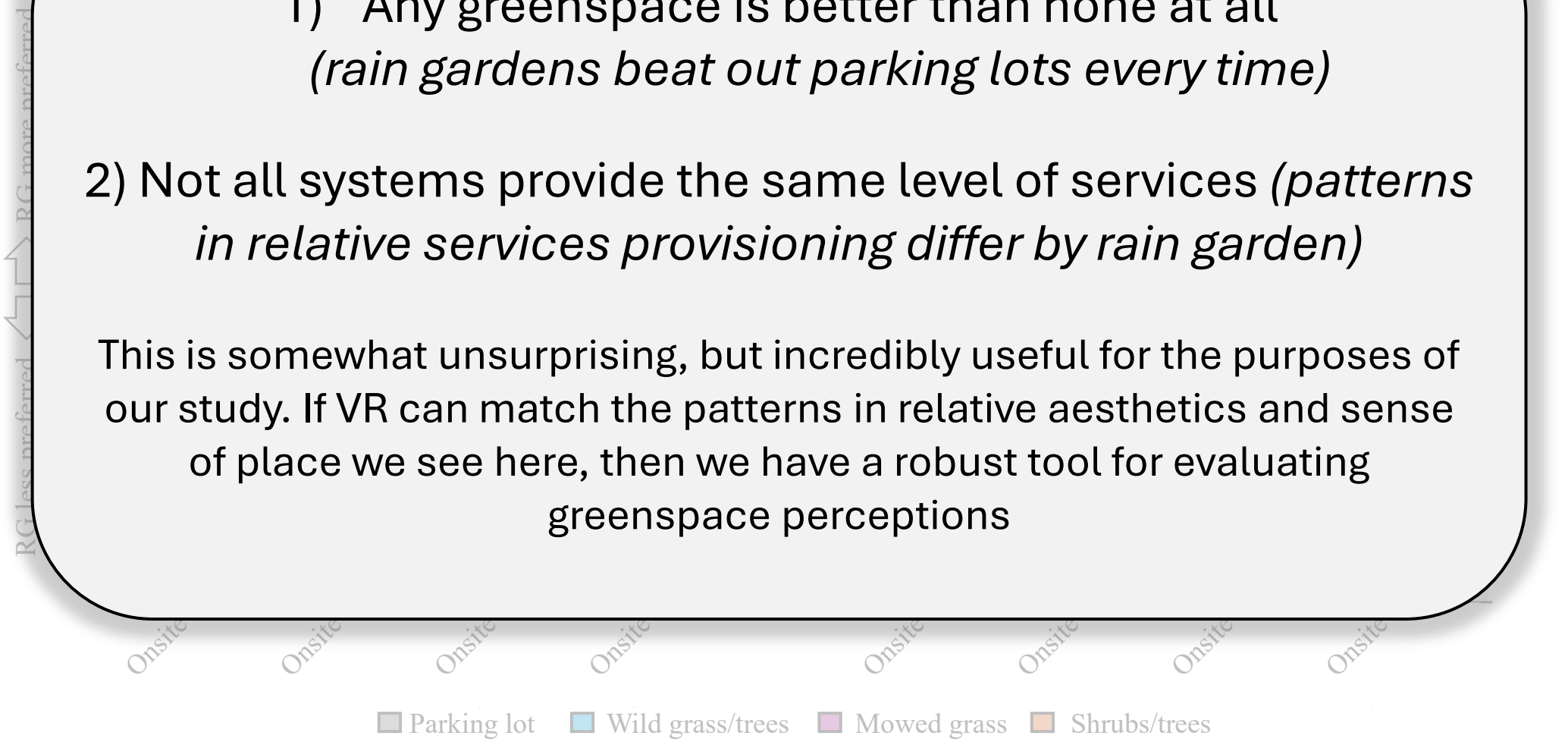


Not all rain gardens are created equal! (UMD creek only has a higher aesthetics and sense of place score than parking lots – 5% higher)

1) Any greenspace is better than none at all
(rain gardens beat out parking lots every time)

2) Not all systems provide the same level of services *(patterns in relative services provisioning differ by rain garden)*

This is somewhat unsurprising, but incredibly useful for the purposes of our study. If VR can match the patterns in relative aesthetics and sense of place we see here, then we have a robust tool for evaluating greenspace perceptions

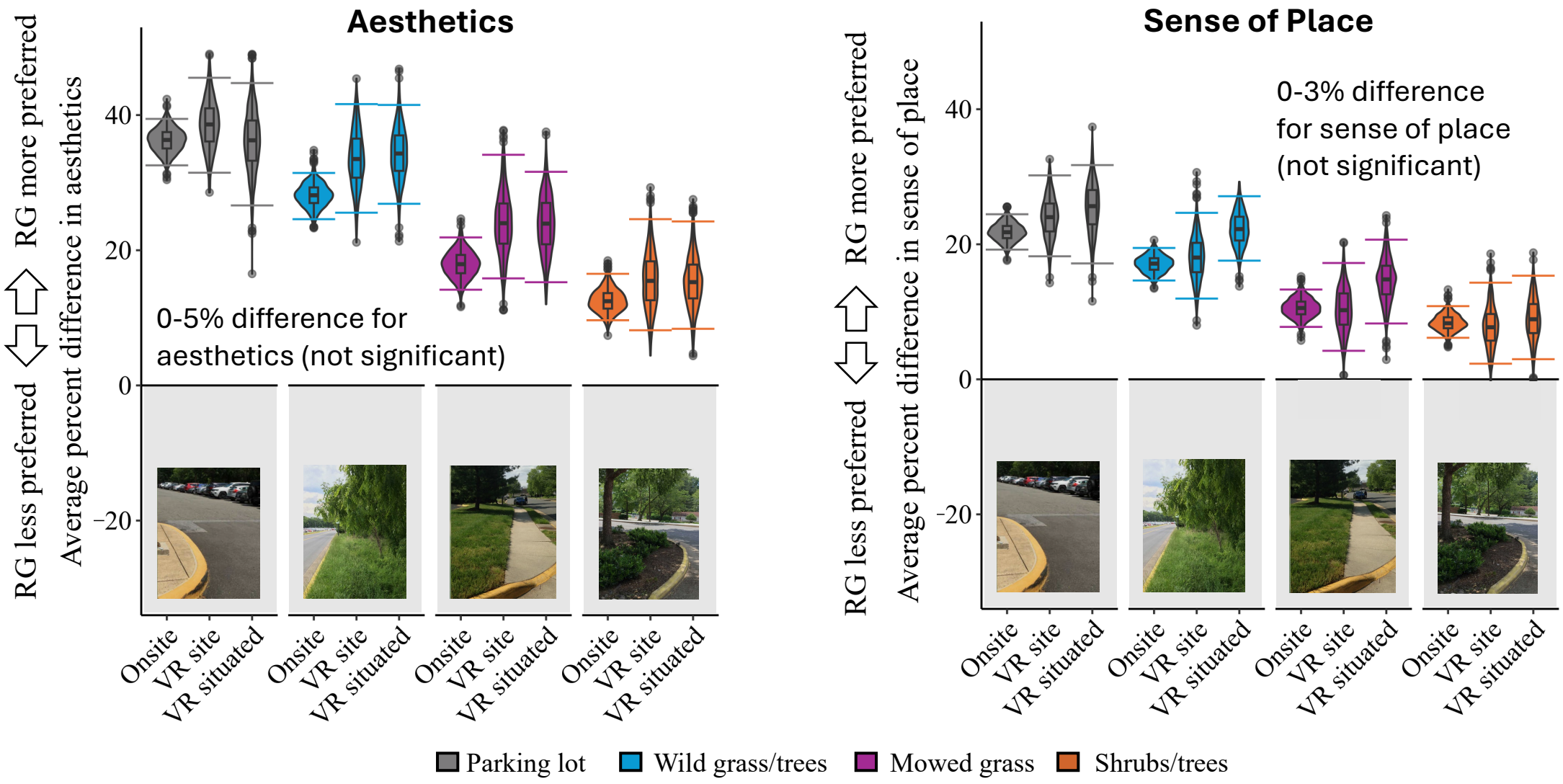


How do virtual systems fare? *Can we reproduce the same kinds of patterns in relative services provisioning that were observed for real infrastructure?*

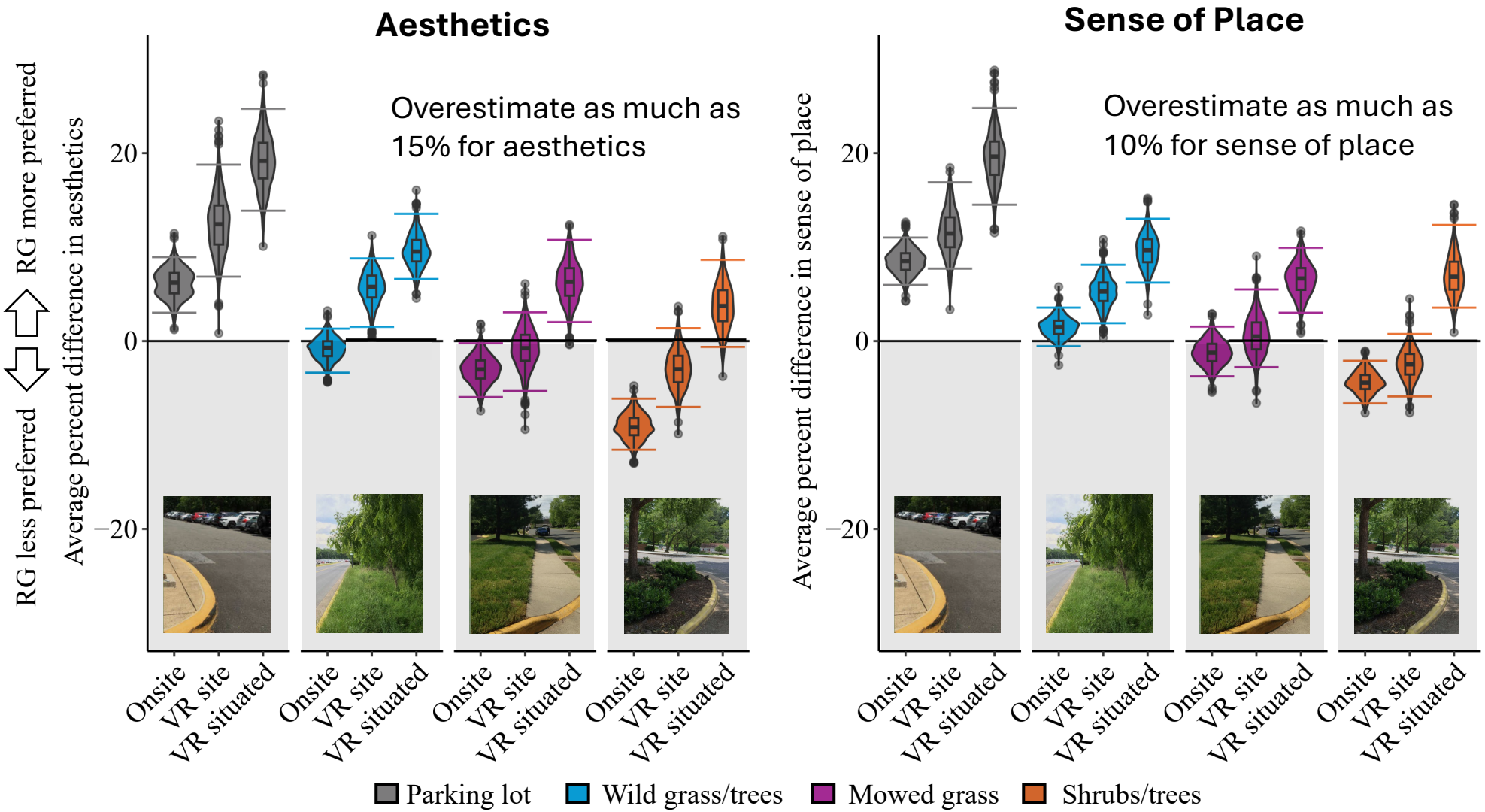
Short answer is a qualified yes *(we reproduce the pattern in landscape preferences well, but not always the magnitude of effect. Situational context can make the situation worse)*

- Start by showing you our well-behaved site (UMD West)
- Then we'll transition to our problem child (UMD Creek)

Virtual models of UMD West capture onsite perceptions well whether situational context is modeled or not



Virtual models of UMD Creek tend to overestimate onsite perceptions (significantly so when situational context is modeled)



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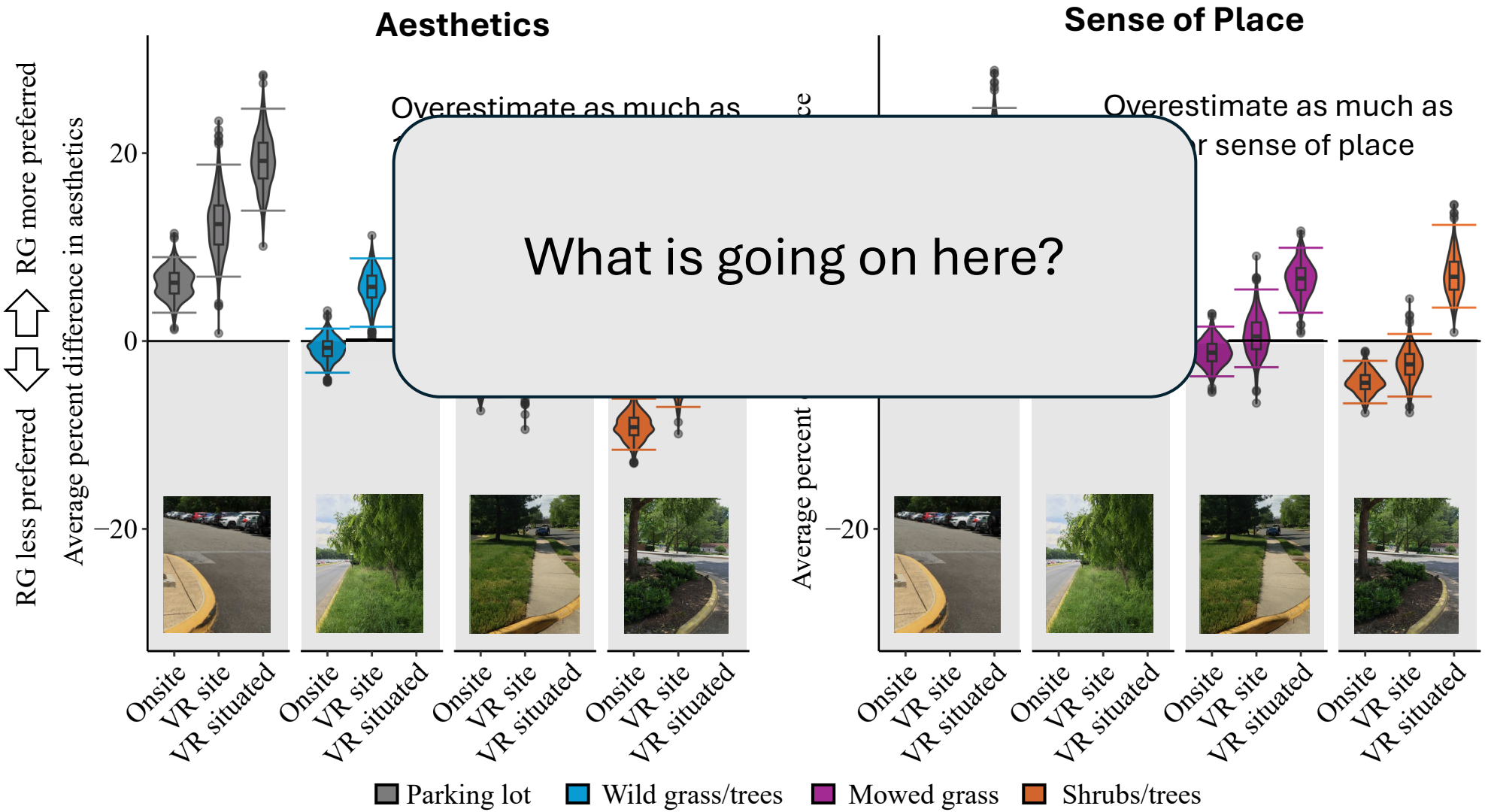


Hard to know for sure, but we do have some suspicions

Other studies suggest that there can be a “Wow Factor” associated with VR systems (people view VR more positively simply because the experience is cool)

- Cultural service scores were positively skewed for both virtual rain gardens, suggesting that this “Wow Factor” may be present in our study. However, the skew detected for UMD West was small (3-5%), suggest that the wow factor is as well.

A more likely explanation for the extreme positive skew of VR sims at UMD Creek is that non-visual sensory information plays an important role in perceived services provisioning

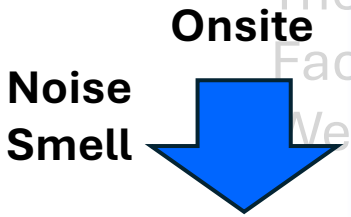
- UMD West is sited in a well maintained, quiet spot near a community garden. It is generally free of traffic noises and odors.
- UMD Creek is situated in a brushy, overgrown area surrounded by a large parking lot. It smells of car exhaust and is noisy and crowded
  - ➢ negative sensory stimuli like these could drag onsite perceptions down

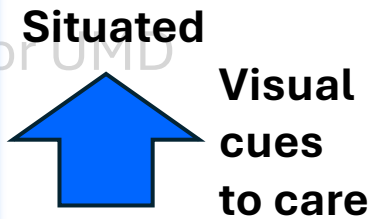
Hard to know for sure, but we do have some suspicions

But if that were the only issue, we'd expect both virtual simulations to be biased the same amount

This suggests that other factors (unintentional introduction of "cues to care" into our virtual reality simulations) may also play a role

Its hard to convey mess and disrepair in a virtual landscape and the larger the site you model the more noticeable its pristineness becomes (the perception that it is cared for and has purpose). We expect these "cues to care" biased perceptions of the situated landscape high





Other stud… tems (people vie…

- The… his "Wow Fac… or UMD Ves…

A more like… k is that non-visual… ovisioning

- UMD W… . It is generall…
- UMD Cree… parking lot. It is noisy, crowded, and there are exhaust fumes and trash
  - ➢ negative sensory stimuli like these could drag onsite perceptions down

Our final pattern at UMD Creek is likely a consequence of two separate processes

Summarize and Conclude

VR can be a useful tool for measuring cultural services *(none of the aesthetic or sense of place scores we measured in our rain garden-only simulations were significantly different than the scores we measured onsite)*

Some things to consider when evaluating VR perceptions

- Factor in a small "Wow Factor" (3-5%) to back correct VR scores
- Provide non-visual sensory information (sound) to capture perceptions more accurately
- Incorporate situational context carefully (*may not always be needed and has the potential to artificially inflate cultural services scores)*

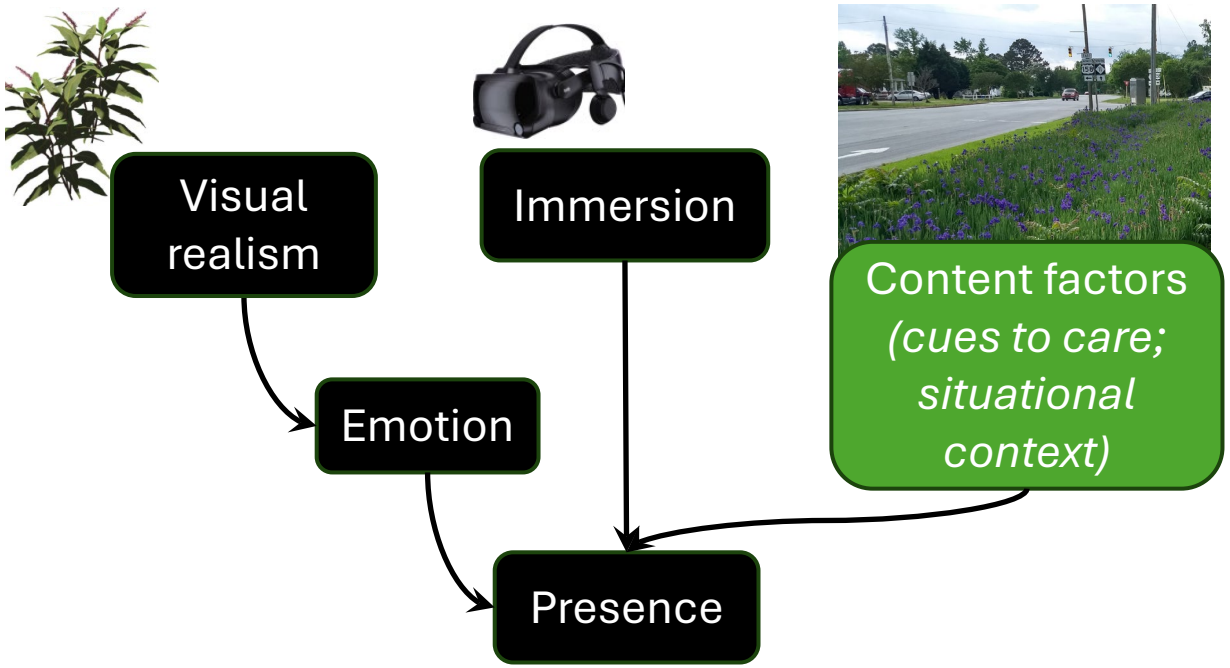
The pristine version of the system we model today is unlikely to represent the way it looks when built (we don't want our VR simulations to mislead, overpromise or disappoint because that defeats the purpose of community-centered design, where meeting community needs is the primary objective)

Thank you

Any Questions?

FIRST STEP: In order to determine whether VR might be a useful way to design for cultural services with communities, we need to determine if the services elicited using VR are realistic

To be realistic VR simulations need to evoke presence "the experience of being there"



Some of the factors that control presence are purely technological

Others are content-related *(what is actually in the simulation and how is it bounded?)*

- For GSI how the simulation is bounded may be particularly important because how infrastructure is situated influences people's expectations of it (what is it for and what "being there" should be like)
- We expect situational context to be an important consideration in VR simulations

Study Design

FIRST STEP: In order to determine whether VR might be a useful way to design for cultural services with communities, we need to determine if the services elicited using VR are realistic

1) Cultural services provisioning by two **real world rain gardens**

2) Built **virtual versions** of the same two systems and evaluated the services they provide
   - Used high resolution landscape models & head mounted virtual reality displays to maximize visual realism and immersion using technological controls
   - Varied the level of situational context people experienced (rain garden only or rain garden + surrounding landscape) expecting that situating the landscape in context would increase perceptual realism because how infrastructure is situated influences people's expectations of it

3) Compared virtual and real-world systems to address the utility of VR approaches for evaluating cultural services provisioning